THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

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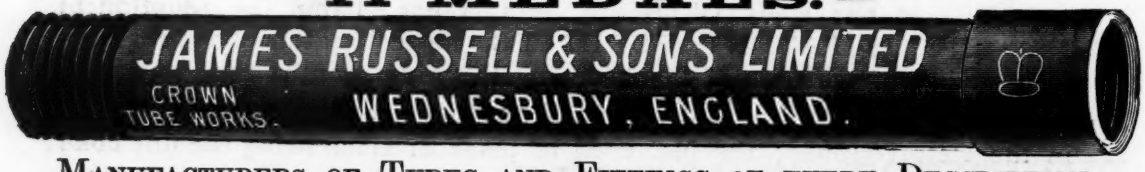

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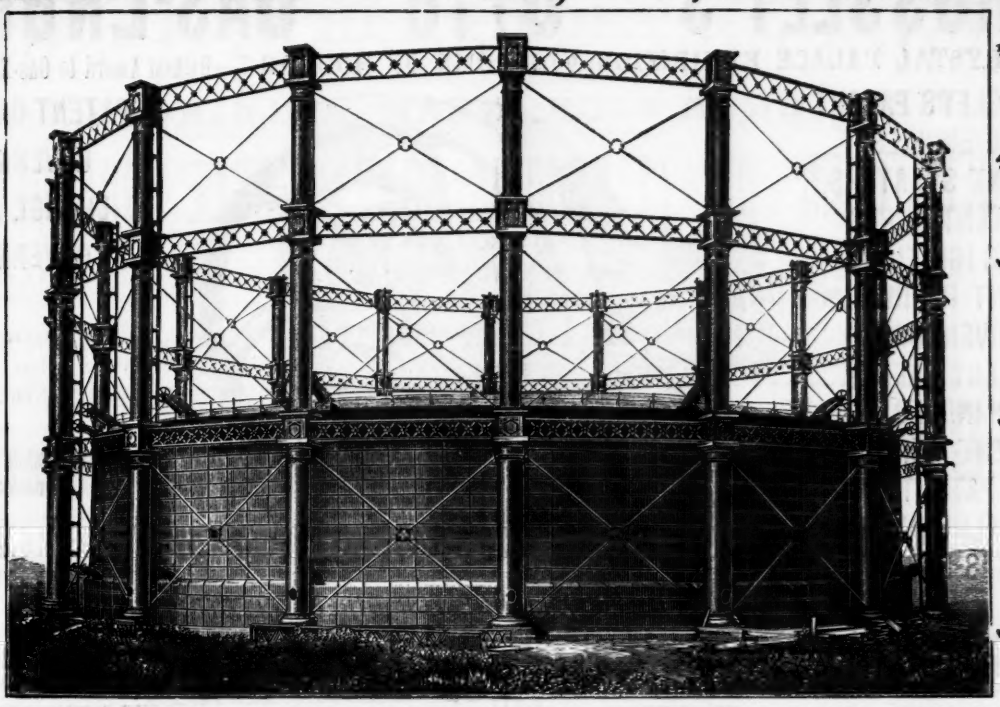

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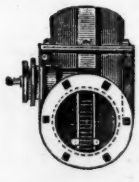

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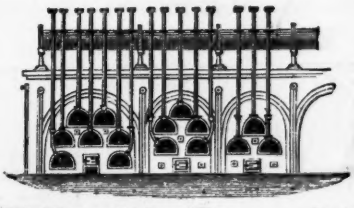

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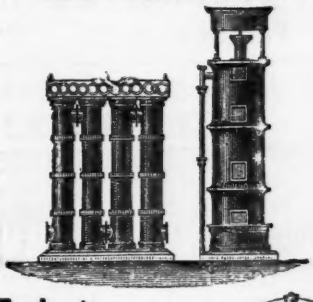

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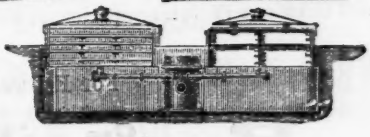

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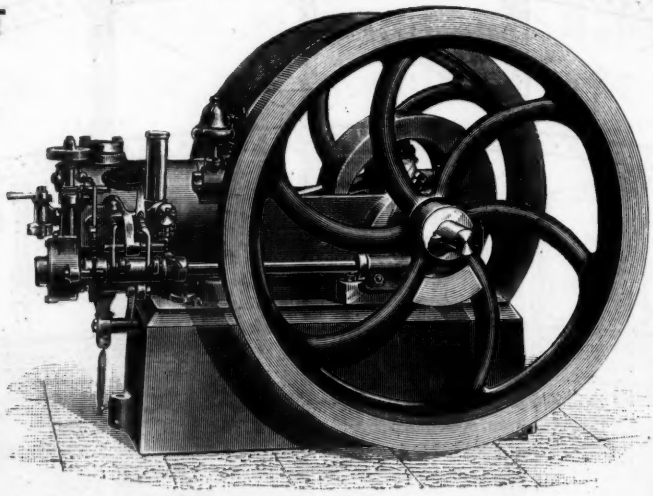

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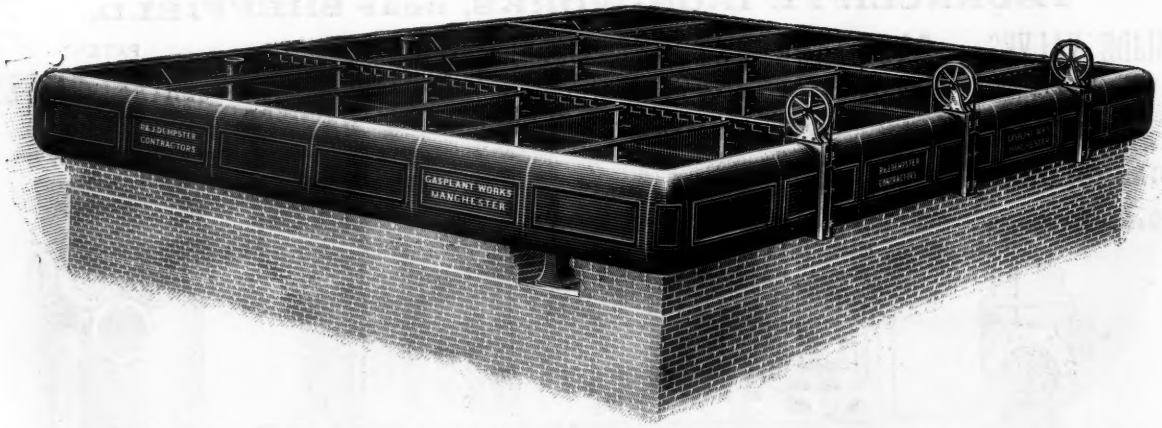

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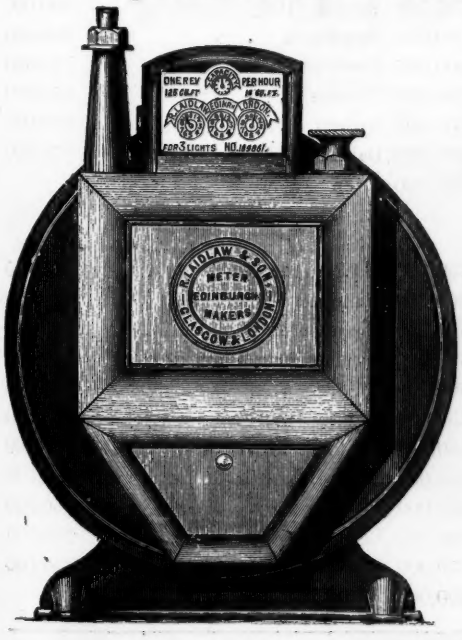

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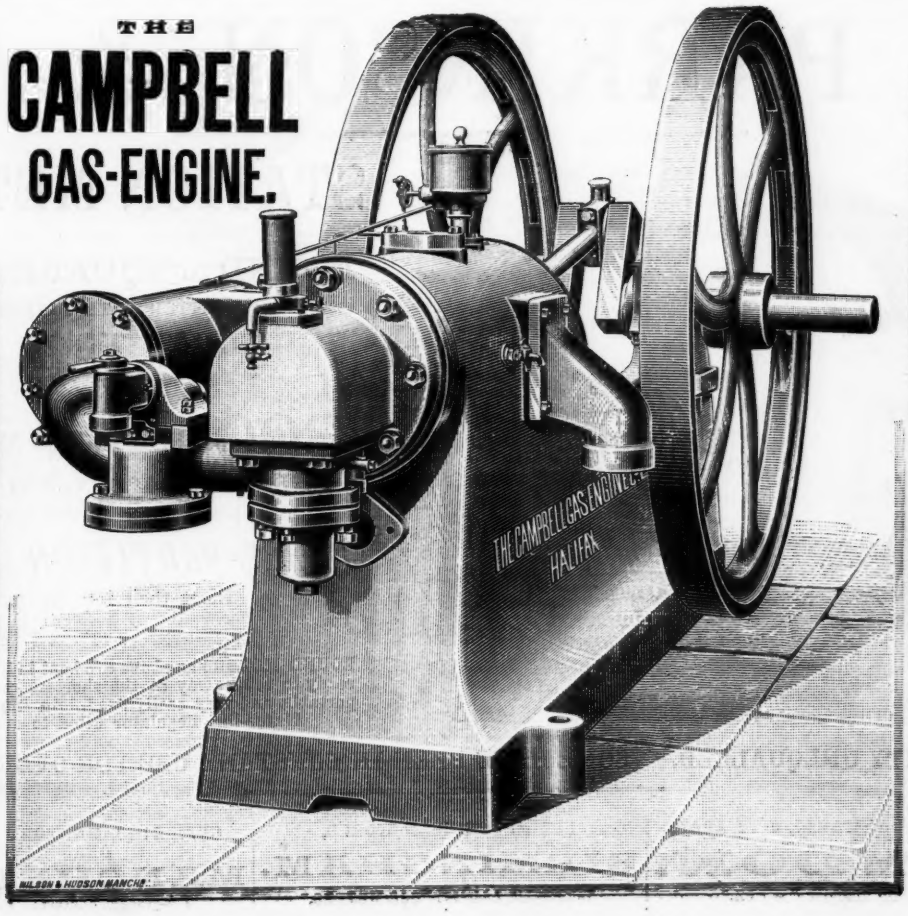

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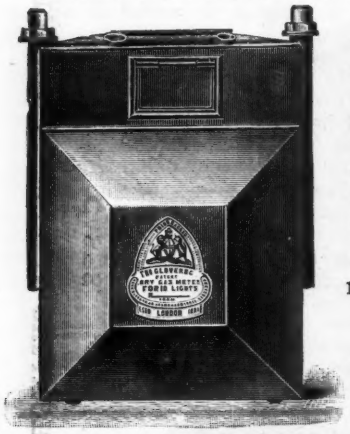

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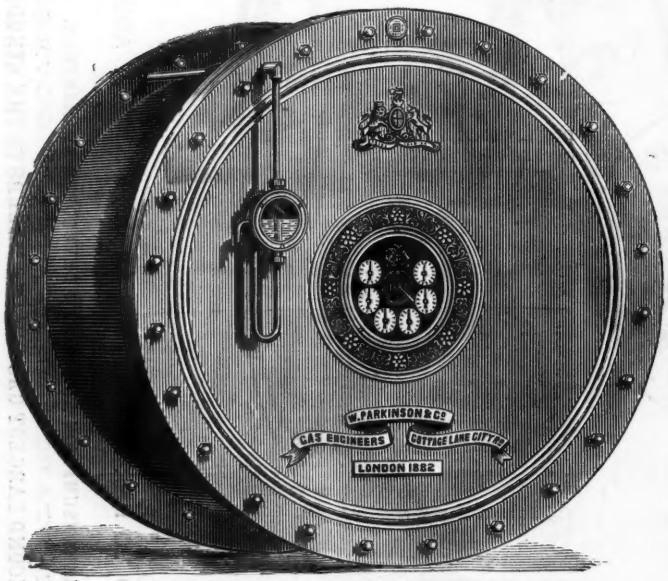

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 19, 1892.

The Fruits of the General Election.

BY the time this number of the JOURNAL reaches the hands of its readers, the General Election will, to all intents and purposes, be over. It is outside our province to offer any comments upon the purely political aspect of the results, so far as these have been made known; and it is consolatory to remember that gas making will go on pretty much as usual, whoever may occupy the Treasury Bench. All the same, there are a few consequences of the elections which may well be noticed here upon general grounds. In the first place, we have been curious to mark the influence in various constituencies of the Labour vote; and it is difficult to resist the conclusion that, upon the whole, that vote has had most effect where there has been no special Labour candidate. After all the fuss that has been made in different places about the formation and strength of a New Labour Party, which was to put the others into the background, most of the candidates who belonged to this New Party came out very badly at the polls. The most distinctive victory that the Labour Party—which, it should be remembered, is also the Socialist Party in this country—can boast, is the return of the redoubtable John Burns for Battersea. Another of the same clique, Keir Hardie, succeeded in South-West Ham—a decidedly working-class constituency. The fantastic Socialist, Cuninghame Graham, failed of re-election to a House where he did no good; and the earnest demagogue Ben Tillett is returned—not to Parliament, but to his faithful Dockers. Indeed, surveying the General Election as a whole, it is evident that, outside a strictly limited number of working-class constituencies, for which it is perfectly right and proper that representatives of the workman class should sit in Parliament, the so-called Party of Labour, of Socialism, Social Democracy, Fabianism, or whatever else it may be called, does not recommend itself to the British electorate. Sectional politics do not yet engage the sympathies of the voter. But it cannot be denied that in many constituencies, where they could not successfully run a special candidate of their own, the Labour Party counts for a great deal in the general total. It must be so at Newcastle, where a *doctrinaire* politician has been unpleasantly reminded of the risk run by parliamentary candidates who are so unfortunate as to lie under suspicion of being unsympathetic to the aspirations of Labour. There are localities where the Eight-Hour Day men are strong; and if their fallacy is ever exposed to their eyes as such, it will not be by politicians whose one great principle is the infallibility of a majority.

It is worthy of remark that some hands are already stretched out to pluck the fruits which a changed House of Commons is expected in some quarters to place within the grasp of the self-styled Progressive Party—the Party that appears to hold the doctrine that the majority of a local authority can do no wrong. At last week's meeting of the London County Council, the Fire Brigade Committee asked that the Parliamentary Committee might be instructed to apply for statutory authority for the compulsory acquisition of land required for Fire Brigade purposes. This demand was reasonable; but it did not go far enough for the ardent spirits who are burning to try to what extent the new Parliament will prove to be in sympathy with the "London program." So it was proposed, as an amendment, that there should be no limitation to Fire Brigade purposes of the project for legalizing the compulsory acquisition of land by the Council, but that general powers should be sought with this object. It was in vain for old parliamentary hands like Sir John Lubbock and Mr. Cohen to utter warnings against the attempt to "rush" a drastic matter such as that of the endowment of a local authority with a roving commission to purchase land compulsorily for anything that might be called a public purpose. If such an innovation is to be entered upon, they said, let it be done openly, and after sufficient consideration, not brought in by a side-wind. But the vigorous Mr. John Burns, M.P., was not to be checked by any such considerations as these. It was for the Council to tell Parliament what it wants; and if Parliament does not listen kindly to everything that is put before it in this way, then the "vigorous" member for Battersea will know the reason why! Well, all that need be said about this is that John Burns has not yet taken his seat. He will have his proper place, and no more, in an assembly which has a singular power of impressing its mark upon all members, however turbulent outside, who are not lunatics. With all his faults, John Burns is no fool; and it is quite within the range of possibility that he may develop into a good working unit among the faithful Commons.

Damages for the Blackburn Gas Explosion.

THE fatal gas explosion which took place at Blackburn last November has resulted in the usual crop of actions for recovering damages; and the report of the hearing at

the Manchester Assizes of the first of these, which was the suit of a widow in respect of the loss of her husband, will be found in another part of the present issue. The facts of the explosion were fully reported in the JOURNAL at the time of the deplorable occurrence, and consequently they need not be recapitulated. The only question for the jury in this case was as to whether there had been such carelessness on the part of the servants of the Blackburn Corporation Gas Department as to render the Corporation liable for the catastrophe that ensued when, as narrated in the evidence, some men not in the service of the Corporation had occasion to touch a nominally disconnected meter. There was a disused and presumably harmless meter in the cellar of a public-house, where it had formerly been housed for the convenience of the Corporation. It was proved in evidence that the so-called disconnecting of the meter by the Corporation's servants consisted in filling the hole in the plug of the main cock with a paste of red and white lead and tallow, and then replacing it. This was the usual practice in Blackburn for effecting temporary disconnections of gas from consumers' meters. Unfortunately, in this particular case, the element of temporality did not enter. The meter was not meant to be used again in that place. If it had been the property of the Corporation, it would doubtless have been taken away and returned to store. As it was private property, it was simply left in its old position; and the union coupling between its inlet and the plugged service was actually left screwed up. What happened was apparently this: The meter was sold, which was a perfectly lawful transaction; and the buyer came to remove his property, which he was also perfectly entitled to do. He was informed that the gas had been cut off; but he found that the pipe connection was intact. He therefore unscrewed the meter union on the inlet side, and was about to disconnect the other, when the end of the service-pipe which he had just been handling *dropped off* from the remainder of the pipe, which was, of course, open to the street main. It was from this broken joint that the gas came to which the explosion was due. Thus the question arose as to who was responsible for this truly remarkable sequence of events. In the result, judgment went against the Corporation—as we consider, rightly, for several reasons. In the first place, knowing that the disconnection of the meter was to be a permanent one, there was no justification for leaving it in perfect physical connection with the live gas service. Whether or not the meter belonged to the Corporation, it ought to have been wholly disconnected from the service-pipe, which should either have been capped off and sealed, if there was any prospect of its being required again at some future period; or, if not, it should have been taken up, and the main properly plugged. If only as a point of economy and the prevention of leakage, it is bad management to leave dead-ended service-pipes full of gas. Again, the escaped gas did not come from any failure of the plugging, but from an open end of the service-pipe left by the accidental breaking off of the length nearest the meter. Evidence was given for and against the question whether this breakage was due to weakness of the joint or to improper handling by the man who was trying to take away the meter which he had bought. Here, again, it seems to us that this is a purely secondary question. The service-pipe never should have been left for anybody to touch, roughly or otherwise, with a lawful excuse. The Corporation have blundered throughout, and they must therefore pay.

Nobody attaches any criminal liability to the Corporation for a mistake of procedure which most likely arose from a stupid adherence to routine practice on the part of their servants. We imagine that, if the subject were sounded to the bottom, there would probably be discovered some such rule as this: When the gas is to be temporarily cut off from a house (for the reason which generally necessitates this operation), it is sufficient to stop up the plug of the main cock with composition. No harm is thus done to anything, and the plug can be cleared in a moment when required. If the meter is to be taken away, the service has to be capped. So far good; but, in the case in point, the Corporation fitters failed to distinguish between the reasons for a temporary or a permanent cutting off, and did not rise to a perception of the great truth that here was an occasion for permanently stopping the service, although the meter was not to be removed. Routine has its victims, just like irregularity. One of the witnesses for the Corporation testified at the time that the so-called cutting off in this instance was "well done." No doubt; but it is something to be borne in mind that what is very perfect routine may yet amount, in the eye of the law, to carelessness entailing pains and penalties upon the perpetrator.

A Fuel-Gas Scheme for Birmingham.

As will be seen elsewhere, the indefatigable Mr. B. H. Thwaite has "broken out in a fresh place." This time he wants to see the relics of the unfortunate Birmingham Compressed Air Company taken over by the Corporation, and adopted for a trial on the large scale of a system of fuel-gas manufacture and distribution. The idea has been suggested by the fact that the compressed air plant is actually on the spot, and might probably be had cheap by anybody who should fancy that something could be done with it. Anyone who chooses to dig down through the mass of superfluous verbiage with which Mr. Thwaite has chosen to weight his suggestion, will find that it consists in making a mixture of ordinary Birmingham Corporation coal gas with "non-luminous but purified generator gas, "proportional in such a measure as to produce 12-candle "gas." It will be perceived, from this and other passages of Mr. Thwaite's writings, that his English is anything but pure or luminous, whatever his generator gas may be. However, not to insist overmuch upon this aspect of the paper, which we publish in order that the author shall not have cause to complain of our turning a "cold shoulder" to everything but coal gas, we will proceed to deal with Mr. Thwaite's subject-matter, apart from his style. This proposed mixture is to be compressed at the distributing station kindly built by the defunct Air Power Company, and sent out under a pressure of "from 4 to 8 inches of water," at which Mr. Thwaite says that "practically the same heat-"ing power could be passed through the mains as with "lighting gas." It is not necessary to follow this ingenious author through all the rule-of-three sums whereby he endeavours to prove that it would do Birmingham coal gas good to be reduced from 17·4 to 12 candle power by the admixture of non-luminous generator gas. He tangles himself up with these calculations, but vainly. What conceivable good could ever be gained by letting down a 17-candle gas by 5 candles? Mr. Thwaite seems to think that it would take a great deal of "purified generator "gas" to effect this change. But producer gas is as bad as air in its effect upon illuminating power, and for the same reason—its heavy proportion of useless nitrogen; and therefore 6 or 7 per cent. of it would do all that Mr. Thwaite requires in this regard. He may contradict this statement; but we must make it clear at once that no such contradiction, unaccompanied by a report from a reliable and independent expert, who shall have ascertained the facts by means of direct experiment, will have weight with us or with our readers. Frankly, Mr. Thwaite's whole paper is too windy to be taken seriously. He tries to build up an imposing evidence of phrases; but there is no stable foundation for it. The Birmingham compressed air power scheme was much more soundly based. From the engineering point of view, there was good reason for this venture; but what has been its fate? The compression-engines and pipes remain, it is true; but these are good for squeezing gas up to 45 lbs. pressure. Mr. Thwaite does not contemplate anything of this kind, but talks of a presssure of a few inches of water, hardly superior to that of the ordinary gas supply. Mr. Dugald Clerk has been prevailed upon to give a qualified assent to Mr. Thwaite's proposal; but he is careful not to commit himself very deeply—never venturing beyond generalities. Material civilization, however, is not to be advanced by general observations. It is the concrete experience that tells. How is it that neither Mr. Thwaite nor Mr. Clerk is able to inform us of a single instance in the whole civilized world where fuel gas, as distinguished from lighting gas, is made and sold at a profit? And if this has not been done out of "Birmingham (England)," what is the exact economic value of the supposed advantages which exist in this locality for the trial of an experiment that has never succeeded elsewhere? Putting aside all "tall talk," which is never worth the paper on which it is written, and is peculiarly out of place in a technical communication, will Mr. Thwaite answer the questions we now put to him? He had better do this before his paper is committed to the tender mercies of the Gas Engineers of the Birmingham Corporation.

"When Water-Gas Operators Fall Out——"

SOMETHING strange has been going on across the Atlantic between the old and the new leaders of the water-gas interest. It appears that not long since a split occurred in the financial and gas engineering clique who were known to fame, more or less creditably, by the name of the United Gas Improvement Company, of Philadelphia. For some years this coterie enjoyed the monopoly of management of the Lowe water-gas patents; and having intimate connection also with the Standard Oil Company, who controlled most of the trade in the oils best suited for water-gas manufacture, they did wonders, and, using any means that came to hand, they made water-gas "hum" throughout the States. The recent development of water gas in North America, as we have repeatedly pointed out, has been due far more to stock operations conducted by or in the interest of the "U. G. I." than to any intrinsic advantage of water gas as compared with coal gas, though we have not denied that there are places where the former is a more advantageous manufacture than the latter. We have yet to learn, however, that the consumers of gas anywhere have participated in this advantage. For keeping this view of the much-vaunted progress of water gas in the States before our readers, we have frequently been honoured by the unmeasured abuse of the subsidized "organs" of the water-gas schemers. To return to the subject of the schism among these gentlemen, however, it seems, from what can be gathered from some acrimonious correspondence recently published in the *Progressive Age*, that, while the United Gas Improvement Company owned the Lowe patents, there were some others in use by gas companies making water gas which were claimed to be independent of the former; and among them was the Springer patent, owned by the National Gas Light and Fuel Company, of Chicago. Operations were set on foot for the acquisition of the latter concern by the United Gas Improvement Company; and they were ultimately completed. Thereupon, though not until after some little time, the former President of the absorbed Chicago concern severed his connection with the Philadelphia people, and started a new venture called the National Gas and Water Company; fixing his head-quarters in the very suite of offices previously occupied by his old organization, and dealing in a modified form of water-gas plant called the "Morrell cupola" apparatus, after one of the partners. Of course, the United Gas Improvement Company could not brook this conduct on the part of seceders from their lines; and so they brought an action, through the absorbed National Gas Light and Fuel Company, which has no longer an independent existence, against some customers of the National Gas and Water Company, for infringing their Springer patent by using the Morrell plant. The attacked Company are defending themselves vigorously. To the accusation advanced by the United Gas Improvement Company that they are carrying on a colourable imitation of the business which they parted with when the National Gas Light and Fuel Company was absorbed, the seceders allege that they were forced to retire from association with the "U. G. I." because the management of the latter sought to involve them in what they regarded as dishonourable conduct. So the quarrel rages deep and fierce between these whilom associates; and the Water Gas Companies of the United States look on the fray with fearful joy. There is an old proverb which may perhaps occur to mind in connection with the falling out of these gentlemen; but we shall not repeat it.

Title and Index to Vol. LIX.—The title-page and index to Vol. LIX. of the JOURNAL (January to June, 1892) will be ready in a few days; and, as usual, a copy will be forwarded post free by the publisher, on receipt of a post-card from any subscriber.

North of Ireland Association of Gas Managers.—We learn from the Secretary of this Association (Mr. J. Whimster, of Armagh) that a very attractive programme has been arranged for the forthcoming annual meeting of this Association, which will take place in Dublin early next month. In addition to the Inaugural Address of the President (Mr. D. M'Callum, of Omagh), there will be two papers, a short lecture by Professor Tichborne on the chemical properties of coal gas, and an exhibition and description by Mr. J. R. Wigham of his high-power lighthouse burner. These matters will fully occupy the attention of the members during the time allotted to the business of the meeting; but they will no doubt, as on previous occasions, be followed by a pleasant excursion.

WATER AND SANITARY AFFAIRS.

SIR T. FARRER resolutely asserts that the question at issue in reference to the purchase scheme of 1880 "is not "whether London would or would not have made a good "thing out of Sir R. Cross's bargain," but is something altogether different. Yet we rather think that this is the point which more especially interests the ratepayers, though it may answer a controversial purpose for Sir T. Farrer to ride off into an inquiry as to "whether the "annuities Sir R. Cross proposed to pay the then share-"holders in Water Companies by way of compensation "were or were not greater than the value of their shares." This strikes us as a very narrow view to take of a subject comprehending various financial considerations. Through fear lest certain shareholders should be perhaps rather handsomely compensated, Sir Thomas Farrer would throw over a bargain without considering whether or not it would be "a good thing" for London. Sir Thomas thinks it would be too troublesome a task to estimate what the Municipality "might "have made" by a transfer of the undertakings. He would have "to examine the long array of figures in Mr. "Burdett's book," some of which figures he believes to be "extremely questionable." This imputation has very naturally brought Mr. Burdett upon the scene, who requires that Sir T. Farrer shall either withdraw his remark as to the aforesaid figures, or substantiate his charge as to their "questionable" character. Mr. Burdett states that the chapter on the London Water Companies in his "Official Intelligence" is "an impartial statement based "upon official documents and figures." Sir T. Farrer also flouts the writer of the letters in *The Times* signed "Accountant," signifying that he may possibly be "a "supporter of Sir R. Cross, or the writer or the prompter "of the article in Mr. Burdett's book, or a servant of the Water Companies, or all three." This, assuredly, is "not "the question," but simply serves to show that Sir T. Farrer is getting rather angry.

In pursuance of this subject, we may observe that in the course of the inquiry instituted by the Corporation of the City in 1890, and of which Sir W. Guyer Hunter was Chairman, evidence was given by Mr. Samuel Wood, of the firm of Messrs. Alfred Lass, Wood, and Co., as to the effect that would have been produced by the adoption of the terms proposed by Lord Cross for the purchase of the Metropolitan Water-Works. Mr. Wood's calculations came down to 1888-9, and compared the annuities which would have been payable on the 3½ per cent. water stock, ordinary and deferred, with the profits which had actually been earned by the eight Metropolitan Water Companies. The total profits in the nine years from 1880-1 to 1888-9 inclusive, amounted to £9,286,830. Reckoning £1,275,561 payable during the period for interest on preference and debenture stocks in existence at the date of the proposed purchase, and £8,080,990 for annuities on the ordinary and deferred 3½ per cent. water stock, we get a total of £9,356,551; thus creating a deficiency of £69,721. But during these nine years, the Companies raised additional capital to the extent of £2,237,425. This amount, if it had been raised at par at 3 per cent., would have required £295,584 for interest during the nine years; thus increasing the deficiency to £365,305. Mr. Wood allowed that the purchasing authority would have gained about £15,000 during the first five years. He shows a gain of £32,000 in the first four years. The estimated deficiency comes after 1885; and Mr. Wood acknowledged that this was "partly attributable "to the amended basis of charges for water supply," enacted in 1885, and "the check caused thereby in the "increase of the Companies' receipts." That the basis was "amended" we do not admit. That the change which declared that within the range of the Metropolis "annual value" should be taken to mean "rateable value," was hurtful to the Companies, cannot be disputed; and it was clearly intended to be so. But the calculation does not end here; Mr. Wood himself specifying that the deficiency "is subject to allowance from the reduced amount of "capital and of expenses which would have been incurred "under consolidated management." What this would amount to is shown by Mr. Burdett, who takes Mr. E. J. Smith's figures, and calculates on a reduction of working expenses to the extent of £96,000 per annum, or £1,080,000 down to Sept. 30, 1891. Other items have to be included; making the apparent net loss to the ratepayers,

by the abandonment of Lord Cross's scheme, as much as £947,000. Mr. Burdett allows a deficit of £690,835 in the bare comparison of the net income with the amount required for interest on the water stock; and yet, when other items are allowed for, the final result comes out largely in favour of the terms proposed. Mr. Wood gave brightness to the prospect, had Lord Cross's scheme been accepted, by saying in his evidence: "There were to be no more additions to the deferred stock "after 1892, from which date, other things being equal, "the income would begin to overtake the annuities." If all the elements of the problem are dealt with, we cannot see that there is any practical difference between Mr. Wood's evidence and Mr. Burdett's calculations.

The inauguration of the Vyrnwy water supply at Liverpool last week, by the Duke of Connaught, marks the virtual completion of an engineering enterprise of extraordinary magnitude and the greatest sanitary importance. Liverpool stands next to London in the number of its inhabitants; and the area over which its water supply is distributed comprises a population of 800,000. The works now opened will give a supply of rather more than 13 million gallons per day. This, of course, is insufficient to meet the full demand; the average consumption at the present time being 20 million gallons per day, equal to about 25 gallons per head. But as yet only one pipe is laid, whereas there will ultimately be three, by means of which a supply of 40 million gallons a day will be available from Lake Vyrnwy, which, at 30 gallons per head, will suffice for a population—such as may occur in the future—of 1,333,000. The new works for the supply of Liverpool have been a matter of absolute necessity; those hitherto existing having become inadequate to meet the wants of the population. The capital outlay so far may be put at £2,000,000; for which, in the first instance, a supply of about 13¼ million gallons per day is to be given. The capital expended on the London Water-Works to the close of 1890 was £15,000,000, while the average daily supply exceeded 175 million gallons. Thus for little more than seven times the capital, London has thirteen times the Liverpool supply. By the time—a very remote one—that the Vyrnwy supply has been trebled, there must, of course, be some further expenditure on capital account. How far this may go, so as to retain for London its present economical superiority, is a question we cannot determine without further data. The magnificent works by which the new supply is brought to Liverpool makes the expenditure of £2,000,000 appear moderate; and the Engineer—Mr. G. F. Deacon—deserves the utmost credit for the ability with which so vast an enterprise has been designed and carried out. By means of a gigantic masonry dam, the waters of the Upper Vyrnwy in North Wales have been impounded, and a reservoir created nearly five miles in length. From this point to the distributing reservoirs at Prescot is nearly 70 miles. The aqueduct is described as the longest yet constructed; and the impounding dam is itself unrivalled. The passage under the Mersey is a great achievement; and eleven years of labour are now brought to a satisfactory termination. In what degree this undertaking is to be an example for London, is a matter on which opinions will differ. London, it is to be remembered, is not as Liverpool, seeing that as yet there is no proof that the Metropolis is under the necessity of seeking a source of supply beyond its own watershed.

North British Association of Gas Managers.—The thirty-first annual general meeting of this Association will be held in the Albert Hall, Stirling, on the 28th and 29th inst.—Mr. A. MacPherson, the President, in the chair. According to the programme issued by the Secretary (Mr. R. S. Carlow, of Arbroath), the first day's proceedings will comprise the usual routine business, the delivery of the Inaugural Address, and the reading of papers. These comprise one on "Coal Analysis," by Mr. J. M'Crae, of Dundee; one on "Enriching Coal Gas by Paraffin Oil or Liquid Hydrocarbons," by Mr. J. Mackay, of Peterhead; and one on "How to Keep Down Complaints and Grumbling amongst Gas Consumers," by Mr. G. Keillor, of Nairn. In addition to these, there will be a discussion on Mr. D. Macfie's paper on "Regenerative Gas-Lamps," read at the last meeting; and the "question-box" will be available for those who are desirous of making use of it to obtain information from their colleagues. The second day will be devoted to the ceremony of unveiling the bust of Murdoch in the Wallace Monument (which will be performed by Lord Kelvin); and a drive in the afternoon through the grounds of Keir to Doune.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 139.)

THINGS seem to be going from bad to worse in the Stock Exchange. Dull enough they were before; but now they are absolutely flat. Several causes contribute to this position. First comes the General Election; and the growing preponderance of Gladstonian successes steadily depressed the markets. The Foreign Market was specially affected; since it is in our foreign relations that the greatest upset and muddle are to be feared. The Stock Exchange is an excellent political barometer; and there can be no doubt as to which party John Bull would rather trust his money with. Then the reduced dividends declared by some of our home rails have been depressing. They, of course, are the consequence of high wages and dear coal, coupled, in the case of the great coal-carrying lines of the North, with the Durham strike. Nothing need be said about the Money Market; the value of money being so low as to be almost beneath notice. The Gas Market has not been very active; but the strong disposition towards a general recovery in prices which was manifested in the previous week has been well sustained. The Metropolitan Companies evince this to the most marked extent. In Gaslights, the "A" was steady throughout at about 212. The secured issues, both debenture and preference, were firm at recently advanced prices; and the "H" 7 per cent. limited made a substantial improvement. South Metropolitans were only moderately dealt in; but the tendency was favourable. "B" added 2 more to its advance of the previous week; and the debenture stock was fractionally higher on *ex div.* adjustment. Commercials were quiet and firm; the old stock being quoted 2 better. Not a single transaction was marked in any one of the Suburban and Provincial undertakings; and all quotations remain unchanged. The Continentals were inactive, but very firm; all transactions being at very good figures. The rest offer no remarkable feature; the only variation was a fall of ¼ in Bombay new. Water has been quiet and steady; and shows no sign of alarm at the approach of a Gladstonian *régime*.

The daily operations were: The Gas Market opened without change, and remained firm through the day at the old quotations. Business was very restricted on Tuesday; but the prices marked showed undiminished firmness. Gaslight "H" rose 3½. In Water, Grand Junction rose 1. On Wednesday, there was even less doing; the stagnation point being almost approached. However, there was no shrinkage in values for lack of support; and Commercial old advanced 2. There was considerably more activity on Thursday, coupled with good steady prices. Bombay new fell ¼; probably owing to causes connected with silver, and not affecting Gas generally. On Friday, all Gas issues dealt in were firm and unchanged. Saturday exhibited the usual quietude; and nothing moved, except South Metropolitan "B," which advanced 2 more.

ELECTRIC LIGHTING MEMORANDA.

A New Terror of Electrical Distribution—Electrical Definitions—A Ridiculous Blunder—The Electric Light at Oxford.

THE electricians threaten to introduce a new horror into our streets, beside which sky-signs and other known devices of the Advertisement Fiend will be comparatively void of offence. When, a few months ago, Mr. Tesla showed how our old friend of the lecture-room, the vacuum tube, could be made luminous by being merely held near a conductor carrying an alternating current at high voltage, the demonstration, although striking and pretty, did not appear to promise any practical results. We have not had to wait long, however, for the inevitable suggestion for the "utilization," of this phenomenon. It is to be included among the resources of that other product of modern civilization, the Advertisement Contractor. Briefly described, the idea is that vacuum tubes shall be formed into any device to which the attention of the public is to be attracted, and then a high-pressure current shall be obtained from the street mains, which, by suitable manipulation, shall be caused to render these tubes luminous. We should not be surprised if this suggestion were accepted as an additional inducement for the adoption of alternating high-pressure systems of electrical distribution for populous centres. The prospect that high-voltage currents can be used for advertising purposes may be very consolatory to the managers of central station companies, solicitous, before all things, for a "paying load;" but it is not reassuring to others.

Common people whose education has been so neglected as to render the attempt on their part to follow electrical calculations painful and unsatisfying, may take courage from what was recently said in Court, in the course of an electrical patent appeal case, by learned Counsel who essayed to instruct the Bench in this recondite matter. It was necessary to define what was meant by the term "ampère-hour." Lord Justice Kay, with true judicial innocence, asked Counsel the meaning of the term; and he was answered, according to the *Electrician*, by the

following lucid analogy: An ampère-hour is not exactly an ampère or an hour; but it closely resembles both, combining their useful qualities, and eliminating their incidental drawbacks. Suppose you have an income of £500 a year, then the number of year-pounds, according to or corresponding to the unit of time, gives you the rate of expenditure, and the sum in one hour therefore corresponds to one ampère; and so the amount is an ampère-hour. Another very clear illustration may be taken from a stream of water which flows at so many gallons per minute—the gallons corresponding, of course, to the ampère; so 500 gallon-minutes—that is, ampère-hours per gallon, so to speak—is the total quantity or current which measures the rate of flow in unit time for each gallon-hour per minute. So one hour flows for each gallon or ampère, and corresponds to an ampère per gallon for each hour. "That is an ampère-hour." No wonder the Judges did not clearly understand the matter until they had talked it over with a few professional electricians and looked up some text-books.

Our usually fair contemporary the *Electrician* fell into a ridiculous blunder in the paragraph about the ratio of the use of electric lighting to the consumption of gas in London, which we reproduced on page 64 of our last week's issue, as an illustration of the way in which electricians' statistics are sometimes made up. Having first computed the equivalent in gas-burners of the number of 8-candle incandescent lamps supposed to be in use at the present time in London, our contemporary calculates the consumption of gas by these burners *for a year*, and works this out as a percentage upon the output of The Gaslight and Coke Company for the last *half year*, when it comes to 6·64 per cent. Of course, it should be only half this rate. But this is not the worst of it. In order to arrive at the equivalent number of gas-burners to electric lamps, the *Electrician* coolly assumes a nominal 8-candle lamp to represent a gas-burner consuming 5 cubic feet of gas per hour, which, by Act of Parliament, must give a light of 16 candles. If some descriptions of gas-burners give less than this amount of light for a consumption of 5 cubic feet of ordinary coal gas per hour, which we do not deny, there are also many other kinds of burners which give very much more light for the same consumption. It has, moreover, been admitted by electricians over and over again, that for ordinary all-round lighting a so-called 16-candle incandescent lamp is not so effective as a 5 cubic feet gas-burner. But if in making a comparison between the popularity of electric lighting and gas in a particular town, the electricians are to assert the right of halving and doubling the figures on either side of the account to suit their convenience, the sooner they drop all pretence to scientific seriousness for their statements the better. A communication upon this subject from Colonel Makins, the Governor of The Gaslight and Coke Company, appears in our "Correspondence" columns.

According to a description of the Oxford electric lighting installation which has appeared in the *Electrical Review*, this particular plant is designed upon a system not commonly met with. There was the usual Provisional Order-mongering in this case; the statutory permission for the lighting of the city having been originally acquired by the Electric Installation and Maintenance Company, who transferred it to the Electric Construction Corporation, who in their turn shuffled it off upon a so-called local Company; but how much local interest there is in the project, may be estimated by the fact that the General Manager of the Company is Mr. George Offor, whose address, like that of Mr. Robert Hammond, has for many years been *Ubique*—which may be freely translated "From House to House." The system which is about to be tried at Oxford is due to Mr. Parker, and is described as continuous-current transformation; current at a pressure of 1000 volts being sent from the generating station to the sub-stations, where it is reduced by motor transformers to the voltage suitable for lighting. The efficiency of the distribution is expected to be very high. So far as can be gathered, the Crystal Palace District Electric Lighting Company have the only other example of this system, which has not had time to show whether or not it is commercially preferable to its rivals. Our contemporary, in its notice of the plant, seems to doubt whether electric lighting will be largely taken up in Oxford; remarking that "the college heads have in days gone by burnt martyrs; but they have never burnt gas. If, now that electricity is at their doors, they fail to avail themselves of it, enlightenment has not yet dawned on the University of Oxford." It appears to us that the writer of these observations himself needs a little enlightenment both as to facts and as to the obligations of courtesy towards prospective customers.

Death of Mr. E. E. Crombie.—The death is announced of Mr. E. E. Crombie, principal of the firm of Messrs. E. E. Crombie and Co., lately meter makers in the Euston Road. Deceased was a native of Fife, and was educated at St. Andrews Madras College. In early life he went to Australia, and was for some years agent at Ballarat for the London and Australian Bank. Returning to London, he entered into partnership with Messrs. N. Defries and Co., and patented a radial slide-valve for dry gas-meters. The late Mr. Crombie was well known to many gentlemen connected with the gas industry in Scotland. He died at his residence, St. George's Square, N.W., on the 7th inst., from the effects of a gas explosion which took place there about two years ago.

CONVENTIONALITY IN GAS SUPPLY.

In the course of Professor V. B. Lewes's Murdoch Lecture to the Incorporated Gas Institute, he spoke out boldly upon the delicate question of the desirability of maintaining the conventional illuminating standard of London gas; basing his remarks upon the notorious lack of any real connection between nominal illuminating power and lighting effect. He put the query whether in requiring a gas undertaking to supply gas at a particular rated candle power, as measured in the photometer, to obtain which involves the undertakers in a heavy expenditure for carburetting, the substance of cheap, popular gas is not sacrificed to the shadow of theoretical illuminating power. There is no doubt that this is so, and that cities like Edinburgh and London—to say nothing of other towns in the United Kingdom to which the observation applies with equal force—are worse lighted than would be the case if the nominal illuminating power of their gas were lower. To find proof of this assertion, we need only look at Paris, which is recognized in popular parlance as one of the best lighted cities in the universe. Statements to this effect are among the commonplaces of tourists' talk, and occur also in the magazine and newspaper criticisms of city administration which are supposed to be so powerful in moulding public opinion. Ask any non-technical observer which is the best lighted city, Edinburgh or Paris, and he will laugh at the idea of there being any comparison between the two. Tell him further that Edinburgh gas is twice as good as Paris gas, and not far from one-half the price, and he will make some flippantly contemptuous rejoinder about the parsimony of the Scottish people in light and other matters. And, in truth, it amounts to this—that the nominally high illuminating value of some Scotch gas is only intended to enable people to stint their consumption of it, not to render the streets and houses brighter. As for London, of course the same remark does not fairly apply; but it is quite certain that the conventional 16-candle coal-gas of the Metropolis, which is practically 17-candle gas as made, thanks to the Referees, is nothing like so useful to the people as uncarburetted gas would be at the lower price at which it could be sold.

These things are matters of convention, as well as of law; and conventions are among the strongest conditions which the human spirit, so economical of originating effect, has made use of for the saving of its labour and at the same time for binding itself withal. Nobody can mark the acceptance of a convention. It is of the essence of the matter that these understandings should grow up without question or notice; and if it happens to be discovered eventually that any such tacitly accepted rule is irksome, the inconvenience must usually be borne, for there is rarely a possibility of getting rid of it. The people of England were treated recently to an illustration of the power of convention in an engineering matter, which may be mentioned here as it directly illustrates the subject we are trying to elucidiate. This was the final surrender by the Directors of the Great Western Railway Company of the fundamental principle in railway construction for which Brunel so wisely, so gallantly, and, as it has proved, so vainly contended—the broad gauge. Railway engineers and traffic managers are now agreed that Brunel was right in his views on this most important point of the best gauge for a first-class trunk line. There is nothing in favour of the now universal narrow gauge for Great Britain beyond a certain saving of first cost in making and equipping the line. After this, everything is on the side of the broad gauge—speed of trains, economy of engine performance, and capacity for dealing with enormous traffic. Yet convention has been too strong for engineering prescience. When Stephenson applied steam locomotion to railways, he took the gauge as he found it. It already existed, and to have set up another as being preferable, for reasons the validity of which would have been undemonstrable for fifty years, would have simply crushed the new movement. Like the wise man he was, Stephenson did his work along the line of least resistance. He had quite enough to do without undertaking to settle the best gauge for railways, the very possibility of which was not recognized by many besides himself; and so a conventionality was enthroned which nothing that brains and money could do has sufficed to upset.

It is precisely the same with the conventional illuminating power of coal gas. Nowhere has there been any rational attempt to base the illuminating value of a gas supply upon the data which can now be seen to govern the satisfactory solution of such a problem. The only tangible evidence to show that such a task has been looked at—that a particular grade of gas has been esteemed as preferable to others, for reasons admitting of discussion—has reference to the competition of gas with electric lighting, and the apparent popularity of water gas, in New York and some other important cities of the United States. Here it has been stated—with what degree of truth we know not—that coal gas, such as can be made from the material available for the purpose, is not sufficiently brilliant to compete in the public eye with incandescent electric lamps. The electric lighting speculators of the States, it is said, are regardless of how many lamps they break so long as the light is bright; and they set themselves to surpass in this respect the gaslighting which they found in possession. At first, they succeeded—so the story goes. Ordinary 16-candle, or even 20-candle coal gas, looked

dull beside the new incandescent lamps pushed to the utmost limit of endurance of the carbon filaments; and the gas companies began to lose their showiest customers. Not to be so easily beaten, however, the gas companies flew to carburetted water gas, which could as easily be made of 30-candle as of 20-candle power; and then the tables were turned again. Before the high-power water gas, as produced by the new apparatus of the United Gas Improvement Company, for a consumption of about 5 gallons of oil per 1000 cubic feet, the incandescent electric lamps paled their ineffectual filaments; and the only effect of the electricians' competition was thenceforward to increase the business of the gas companies. This is a very plausible explanation of the extended use of high-power water gas in the Eastern cities; but it must, of course, be taken for what it is worth.

Elsewhere, the only way in which the customary standards of illuminating power for gas have been arrived at is that of convention, based upon a growing out of "use and wont." It might be argued with much verisimilitude, if not convincingly, that the adoption of high nominal power cannel gas in Edinburgh, whence the custom spread throughout the country, was due to the early rivalry of coal gas with the oil gas in which Sir Walter Scott was so deeply interested, and which was naturally of high illuminating power. In other parts of the kingdom, the customary standard of illuminating power grew out of what was understood to be the value of the local gas at its best. In the larger towns there was a steady pressure upon the suppliers of gas to obtain the best that could be had without necessitating too great a departure from the established methods of manufacture; and so there was a continual "screwing up" of the standard illuminating power. From 13-candle gas the standard rose to 14, 15, and 16 candles, as better ways of burning it were hit upon. It was generally a question of the burner, however. There was an understanding that the best-known burner, should be taken as the standard means for ascertaining the illuminating value of the gas; and, in return, the gas companies were screwed up to the last candle that the gas would give under this system of testing. There was some complaint about this fashion of basing everything upon the burner, the effect obtained by which was said, and reasonably, to have no real connection with the character of the gas, so that the same gas which was once rated at 13 candles could conceivably be called 16-candle gas merely by charging the burner. This was one of the most hackneyed grievances of the gas agitators at the time when the standard for London gas was settled.

If the public were defrauded by the erection of the burner as the sole indicator of the quality of gas, time has brought their revenge in due course, and it will soon become a question whether the old convention can hold good under the strain which later commercial conditions have brought upon it. Of the data which go to make up the cost of a candle power in the photometer, some are known now with an exactitude which, if attainable thirty years ago, would not then have been esteemed worth cultivating in such matters. The question as it now stands must be carried back to the period when what is known as common coal gas was admitted to be the most suitable product of the kind for London. It was made from the coal sea-borne from the pits of Northumberland and Durham, which also yielded a good coke. As tested by the methods known at that time, this gas was rated at 13-candle power. No cannel was required for producing it; but a small corrective dose was occasionally needed to make up for slips in the manufacturing operations. Wet lime purifiers being used, there was no carbonic acid in the gas to interfere with its illuminating value, which might have suffered, however, from the load of moisture which this method of purification entailed upon it. However this may be, we shall not be far wrong in asserting that such gas as was habitually supplied in London by the old City of London Gas Company was good, unsophisticated common coal gas. It would now stand at about 15-candle power, and might be depended upon to be "always good alike." The gas manager of that period was not worried over-much with regard to his illuminating power. It was the purification that gave him most trouble. If his gas was clean enough, it was sure to be good enough. Now, as it seems, the position is altered, so that the manager has not only to purify his gas, by a standard altogether strange to his precursor, but he must "doctor" it, if required, to please the gentleman at the photometer a mile away.

All this means money, and nothing but money. The query is, however, whether the money is best spent this way. In London we now have a very public-spirited County Council, who do not seem at all inclined to rest content with traditional answers to traditional problems. If the Council are disposed to meddle with the gas supply, as they probably will do, let them pose this question to start with: Which is the most economical description of gas for London—real common coal gas, or the same raised to some fancy figure in order to meet the requirements of photometrical pedantry? And the question of London is the question for every other town and city in the land. Glasgow has taken the matter in hand, and settled it in its own way, notwithstanding the uproar that always rises when any hoary convention is upset. Manchester and Birmingham merely "hedge" in the matter; doing practically what they please in regard to illuminating power, and saying as little about it as possible. Liverpool cannot move. The question will in all probability be settled in London first. Supposing for an instant that the London County Council were to obtain possession of the Metropolitan gas supply, does any sane person imagine they would spend as much as the Companies now do to satisfy the Referees? Not at all; they would obtain a free hand in the matter of illuminating power, and then adopt the policy of cheap gas—as cheap, that is to say, as might be compatible with the securing of a handsome subsidy out of the gas profits in aid of the rates. London would be supplied with 14-candle gas at 2s. per 1000 cubic feet, or thereabouts; and municipalism would never weary of exalting its service above that of the old Gas Companies—saying nothing, of course, about the alteration in the nominal illuminating power; but since this would never be found out, it would not matter to anybody. Great is conventionality, especially in matters of gas supply.

NOTES.

The Winchester and Imperial Standards of Capacity.

Mr. W. K. Means has presented to the Wisconsin Polytechnic Society the fruits of an inquiry into the history of the bushel measure, which he was induced to undertake by having been engaged by a gas company to measure a large quantity of coal on their account. The whole subject was specially reported upon to the Senate of the United States by Mr. J. Q. Adams, in 1820, when the existing American Standards were settled. Although, unfortunately, the United States bushel and gallon have no logical relationship to each other, they are both derived from the same Roman measure, which is traceable to Greek and Babylonian prototypes, and they are nearer to it by one remove than the Imperial measures of the same name. The bushel and gallon first appear in English law in 1266, when the standards in common use were defined. Henry VII. made an attempt to reform the customary measures of capacity, with the result that for 200 years, there were five or six conflicting measures in use. About the year 1700, Parliament arbitrarily selected the Winchester bushel and gallon, which were accordingly legal in the United Kingdom for about 100 years; and having been standards when the United States became independent, they have been kept by them ever since. Certain of the individual States have varied upon this. For example, in 1850 New York had a bushel slightly smaller than the Imperial, and Massachusetts in 1883 made a special coal bushel intended to represent the heaped bushel. The latter quantity is largely left to custom; but when the legal United States bushel is mentioned, it should be borne in mind that what is meant is the old Winchester measure, which has a content of 274·77 cubic inches. The remarkable thing about this communication is its disclosure that coal is still dealt with by measure in some parts of the United States.

Gaseous Incandescent Lamps.

Mr. H. A. Warren proposes in the *Chemical News* the production of a new description of "gaseous incandescent lamp." He remarks that the incandescent property of platinum in most of its allotropic modifications has been noted from an early period; but its brilliancy as a radiant of light in this condition is far inferior to such substances as magnesia, lime, asbestos, and zirconia. As a material from which a thread or film can be worked for the preparation of an incandescent light, Mr. Warren suggests that nothing is more suitable than asbestos itself; but, on the other hand, asbestos possesses none of the properties of platinum with regard to incandescence. Platinized asbestos prepared by immersing asbestos fibre in a solution of platic chloride has been used for various purposes; but it stands very low as an illuminating agent. Besides, the decomposition of the platinum salt destroys the fabric of asbestos by rendering it rotten. In order to overcome this difficulty, Mr. Warren says he has successfully contrived a special combination of platinum in conjunction with zirconia. The filim (*sic*) thus employed is mounted inside a small globe, as shown by an accompanying diagram, which is that of a pair of bulbs placed above one another, and attached by a short pipe. The bottom bulb is connected to a gas supply which admits of a current of mixed air and gas. The system of bulbs has an upper outlet to the air for the waste gases. Every such bulb has a "filim" of the platinized zirconia-asbestos; and the idea is that these, being first heated by the application of a hot wire during the passage of the gas, will keep aglow so long as the current of air and gas flows. Several such bulbs may be fitted upon one gas supply; and it is stated that for advertising purposes an ingenious modification of the device in the form of large letters has been constructed, which may be illuminated by the white-led wires, and so rendered visible at a great distance.

The Effect of Heat upon the Strength of Iron and Steel.

By the use of the new pyrometer invented by Professor H. Le Chatelier, some important investigations into the behaviour of metals when heated have been made by Mons. A. Le Chatelier. In the case of iron and steel, it was found that the elastic limit decreases continuously with rise of temperature. It varied but slightly between 100° and 353° C.; but above the latter limit it increased very rapidly indeed. Beyond 400° and 450° C. it became impossible to measure this properly. With regard to the breaking load, it was ascertained that, after the ordinary temperature was passed, the breaking strain decreased

up to about 80° C., when it rapidly increased to a maximum, which lies at about the temperature of 250° C. for all varieties of the iron and steel tested. Beyond 300° to 350° C., a rapid fall of strength set in; and at 400° C. the breaking strain was of the same value as at normal temperatures. The proportional elongation and contraction of area tests gave varying results both with alterations of temperature and the speed at which the experiments were conducted. Generally, it may be concluded from these experiments that the particularly dangerous period for iron and steel, under the conditions prevailing in boiler and furnace work, is comprised within 80° and 250° C. except with rapid strains or shocks, where it lies between 200° and 400° C.

Crossley's New Self-Starter for Gas-Engines.

A noteworthy illustration of the practical value of a knowledge of scientific principles is afforded by Messrs. Crossley Bros., Limited, in respect of the latest self-starting gear applied to gas-engines of the "Otto" type. It is well known that the difficulty not merely of starting a gas-engine, but of starting it under its full load, has long perplexed the makers of these motors. The new device, as applied by Messrs. Crossley Bros., is credited with the power of starting a gas-engine not only under a full load, but even with a little more power to spare, which is a valuable consideration when machinery has been standing in cold weather, and has grown stiff in its bearings. The new apparatus comprises a hand-pump for compressing a charge of air and gas; and so far it does not present any novelty. The pump, however, delivers into a pipe several feet in length, opening into the motor cylinder through a non-return valve. To start the engine, which generally stops on the compression stroke, the air-valve is propped open, and the pump worked a few strokes by hand, which fills the connecting-pipe, the cylinder, and the air-pipe with an explosive charge. After the air-valve has been closed, a valve on the pump is opened, and a light applied. The resultant explosion strikes back through the pipe to the motor cylinder. But experiment has shown that the effect of the walls of a long pipe of small capacity is to delay an explosion; and therefore in this case the explosion proceeds comparatively slowly—driving before it the greater part of the charge in the pipe until a very considerable degree of compression is attained in the motor cylinder. On the next intake stroke, the contents of the air-pipe are drawn in; and thus a rich charge is secured, which is certain to ignite.

COMMUNICATED ARTICLE.

THE DISTRIBUTION OF FUEL AND POWER GAS IN BIRMINGHAM (ENGLAND).

By B. H. Thwaite, Assoc.M.Inst.C.E., F.C.S.

It is now some ninety years ago, since the illustrious Willie Murdoch startled his Birmingham townsmen by a display of gas lighting at the famous Soho Works of Boulton and Watt; and in ten years hence the centenary of the introduction of this great invention will have to be celebrated. Since this date of the introduction of gas lighting in 1802, there is probably no town with any pretence to civilization unequipped with plant for the manufacture of lighting gas, based on the system introduced by the ingenious Murdoch; and it may be computed that the total expenditure on gas plant reaches several hundred millions sterling. In Great Britain alone, the amount will not be over-estimated at fifty millions sterling. There is no doubt but that the introduction of this handy and convenient illuminant has effected more good for the people morally and socially than all the Acts of Parliament from the time of Edward the First.

It is rather coincidental that Birmingham, occupying a premier position as a progressive Municipality—a town which is at once the envy and the emulation of other corporations—should have been the geographic site of the initiation of gas lighting. It would therefore be magnificently appropriate if this famous town should initiate in Europe at least, the general use, under corporate direction, of the only scientific, hygienic, and economic method by which our great natural fuel resources may be consumed for domestic and industrial purposes.

In the increasingly difficult struggle for commercial supremacy, the natural advantages of one town or country over those of another, will inevitably decide the future victory; and no natural resource is more valuable than that which contributes power and heat. The lavishness with which Nature has endowed the British manufacturer has not met the appreciative return that should have been given, and the flagrant waste of fuel is evident on all hands; so that, if, almost in disgust with such extravagance, Nature has deposited the sooty particles of imperfect and wasteful combustion on the architectural creations of men, and has inflicted periods of fogs as black as the blackest night (carrying in their train death, disease, and misery), such evidences of Nature's displeasure and revolt should not be lost upon us. If we have the advantage of natural fuel resources over our foreign competitors, the nature of such advantages is neutralized if we utilize our fuel wastefully, and the foreigner utilizes his fuel economically.

Wherever fuel or power is cheap, there man proceeds to erect his manufactories—formerly the corn mill by the stream, or the windmill on the hill. Pittsburg, Penn., thanks to its natural gas and other fuel resources, is the centre of a great manufacturing area; and here Nature has shown to the eyes of men, the condition into which fuel should be converted before its use in manufactories and on our domestic hearths. Here fuel gas issues at high pressure from subterranean storeage strata, and is distributed for upwards of 70 miles, for almost every purpose requiring heat. The universal use of this fuel has metamorphosized the atmosphere of this remarkable region; and it will be a source of regret if the exhaustion of this natural gas occurs before the plant for artificial fuel gas is erected. The users of this fuel gas are altogether in its favour—given that its financial cost is such as to permit its economic use.

As an instance of the importance of the advantages of natural resources for producing power, one has only to refer to the mountainous districts of Switzerland, where—thanks to the dynamic power stored in the numerous water-falls, and to the transformation and transmission of such power by the turbine and electro-dynamos—new industries are constantly being developed; and to-day, in humble and primitive cottages, electric power and light can be found, enabling the fortunate Swiss artizan to compete in new branches of industries with those of Birmingham.

How important and vital, therefore, in the face of such future competition is this question of fuel economy! It is the object of this article to demonstrate that fuel gas is the most economical form in which such economy can be obtained; and in the legacy of distributing-mains and air-compressors, the Birmingham Corporation have an opportunity for initiating in England the transmission of fuel power, which, if carried out, would be a fitting sequel to its historic connection with the application of lighting gas.

Given the absence of any other source of power than carbonaceous fuel, the advantage of transmitting such power by converting the fuel into heating gas and distributing the gas along the mains, can easily be shown to be both real and substantial. The transmission of power over long distances by compressed air absorbs, in compression and transmission, a considerable amount of energy, varying with the length; but the maximum useful efficiency for one mile will never exceed 50 per cent. The transmission of power by electricity, taking into account the loss in general use, will not exceed in useful efficiency 80 per cent. of the power contributed to the conductor mains; whereas the expenditure in transmitting gas will never exceed 1-300th of the initial energy supplied with the gas. The cost of power by hydraulic transmission may be taken at 6d. per brake horse power. With gas power transmission all that is required is to move the gas forward at a pressure of 4 inches of water, which is equivalent to 21 lbs. to the foot and is usually quite adequate. To transmit 3000-horse power of gas, only one indicated horse power of energy is required.

Of course, the same law holds good in transmitting gas as for air or other gaseous mediums; the volume of gas that can be sent through the mains depending upon their diameter and their length—varying directly as the square of the diameter and inversely as the square root of the length. A main 9 inches in diameter, and at a pressure of 4 inches of water, or 21 lbs. to the foot, will deliver through 1 mile length of mains, sufficient gas to develop 1260 brake horse power; and at a pressure of 45 lbs. to the square foot, the volume will easily be trebled, or be equal to the development of 3780 brake horse power per hour.

With the slight exception of a loss by the deposition of some of the imperfectly fixed hydrocarbons, there is no loss in the intrinsic thermic value of the gas sent through the mains; whereas, by the transmission of air, there is a loss by thermal convection and radiation. In the transmission of electric energy, there is the loss by bad insulations, and the high resistance of the conductor mains, by which the original energy is somewhat reduced, as already indicated.

The ideal method of transmitting power may be described thus: The intrinsic thermic energy must be distributed from one or more principal central generating stations, and sent through the mains, at pressures corresponding to the requirements, to subsidiary stations, in which the thermic energy is converted into electro-dynamic energy by gas-engines and dynamos, and transmitted for purposes of power, light, and other industrial and widely-increasing applications of electricity, the domain of which is widening day by day with almost "Arabian Nights" magic. This method would enable the undoubted advantages of electric lighting and electro dynamic application to be obtained in the most economic way; and it would avoid to a considerable extent the use of secondary storeage batteries, which add to the cost of electric energy for whatever purpose to a serious degree.

The air compression plant at the central station of the late Birmingham Compressed Air Company is of a high constructive class. It comprises three inverted triple-expansion condensing engines. The high-pressure cylinder is 20 inches diameter; the intermediate one, 30 inches; and the low-pressure one, 48 inches—all 4-feet stroke. The safe piston speed is 400 feet per minute. The fourth engine is of the horizontal type; the high-pressure cylinder is 12 inches in diameter; and the low-pressure cylinder, 18 inches—with a stroke of 3 feet. The safe piston speed is 360 feet per minute. There are, for the first three engines, in all 18 air-compressors of 18 inches diameter;

so that the volume dealt with at atmospheric pressure would be some 13,000 feet per minute.

The air-compressors for the fourth engine are two in number, each of 20 inches diameter. At atmospheric pressure, the volume dealt with will equal 1267 cubic feet per minute. If we take only one-half of the total volume, the distributing energy over the whole area—the horse power energy that can be sent through the mains—equals 14,000 brake horse power.

The mains already laid extend through the following streets: Trinity Street, Mill Lane, Great Barr Street, partly through Garrison Lane, Gibb Street, High Street, Green Street, partly through Bradford Street, Rea Street, Burchall Street, Thomas Street, Henry Street, Glover Street, New Bond Street, part of Coventry Road, Floodgate Street, Milk Street, Oxford Street, and partly through Bordesley Street.

The distributing-mains are most perfectly adapted for the work proposed—they are all lap-welded, wrought-iron pipes; the connections, valves, &c., being specially cast. The principal main, for about 3000 feet in length, is 24 inches in internal diameter; and the branch mains are of varying diameters, of 20, 18, 12, 10, and 7 inches. The mains have been laid in special Portland cement concrete, and brick walled trenches. The top of the trenches is covered with concrete slabs, which can be removed for examination purposes. The mains have all been hydraulically tested up to 300 lbs. to the square inch. The mains cover an area that will at once adequately test and establish the enormous benefits derivable from the distribution of cheap and convenient power fuel; and then the extensions to the main parts of the town would follow in due course.

Even were the ordinary 17·4-candle gas distributed at a reduction on the price charged for illuminating gas, the benefits that would follow would be exceedingly great; but were the gas supplied of lower photometric or luminous value (say, 10 or 12 candles), the popularity of the fuel would far more rapidly spread.

The following comparative estimation demonstrates the thermic advantages of low candle power gas. The comparison of the thermic values has been taken by the evaporation test, as being the only reliable one. A comparison might be drawn between the consumption of gas in different gas-engines of a specific power; but unless these tests are made on the same engine, and the proportion of air was the same, and the conditions of the one are identical in every sense, such a comparison would be useless and misleading. It is well known that anthracite and coke gas have no illuminating power; nevertheless, the power developed by such a non-luminous gas can, by the adjustment of the air, be made to fairly correspond with that of illuminating gas. The relative pressures established with these gases are as follows:—

Gas-Engine "Otto" (9 Nominal Horse Power).

Photometric Value.	Character of Gas.	Average Pressure Developed.
17·4 candles	Birmingham Gas	70 lbs.
nil	Anthracite	66 ,,
nil	Coke	62 ,,

So that we realize that it is not necessary that fuel gas should have in its constitution the luminous producing hydrocarbons to be economically available for gas-engines; and the non-luminous and cheap gas can be so dealt with, by a regulation of the air, as to develop, within a fair margin, the same power. The following table shows varying photometric values and the corresponding thermic values; the thermic or heat value of the gas being determined by the cubic feet of gas required to evaporate 10 lbs. of water:—

Photometric Value. Sperm Candle Power.	Cubic Feet of Gas Consumed.	Relative Greater Percentage Increase of Thermic or Heating Power of Gas in Inverse Ratio to Photometric Value.
10·5	28·00	Unity.
13·5	22·50	5·0 per cent.
14·5	22·00	12·2 ,,
16·5	21·75	26·0 ,,
20·0	20·50	44·4 ,,
22·0	19·75	55·5 ,,
24·0	18·50	59·0 ,,

The following table shows the thermic and photometric values of the gas of Manchester and London:—

Make of Gas.	Photometric Value in Sperm Candles.	Thermic Value in British Thermal Units.	Greater Relative Percentage Increase of Heating Power Ratio, in Comparison with Photometric Value; taking 21-Candle Power and 765 British Thermal Units to be Equal to Unity.
Manchester.	21	765	Unity
London Gas*	20	731	0·33 per cent.
,,	16	729	25·6 ,,
,,	12	686	57 ,,
,,	12†	732	67·5 ,,

* Average of a series of tests. † Dr. Frankland.

Sufficient data has been given to demonstrate, *nemine contradicente*, that it is not advisable to give to full-power gas a high luminous value; and when it is understood that to raise the ordinary lighting gas up to the photometric statutory requirement, an expensive coal of increasing rarity—such as cannel—will be necessary, and that, when this additional ratio of expense required to give the luminous value is added to the ratio in favour of fuel-power gas of low candle power, the advantage in favour of the lower candle power gas is increased. Ordinary English gas coal costing 12s. per ton will give a gas (economically distilled) of 14·75 candles, and above this photometric value, involves in its production the employment of cannel, costing nearly double the value of coal.

The importance of distributing a low candle power gas, approaching the characteristics of the Pennsylvania natural gas, will be demonstrated further on. For converting heat into work, no instrument yet invented equals the most modern developments of the gas-engine; and no modern power invention can be said to have had such a record of unbroken, nor such a striking success. One firm in England alone (and now the names of the makers is legion) has turned out more than 23,000 engines within the last twelve years.

The improved efficiency of the gas motor will be understood by the following statement: The introduction of the first actual practical gas motor dates back to 1860. This motor consumed no less than 2500 litres (89 cubic feet) of gas per indicated horse power; and required 33 gallons, or 150 litres, of jacket water. The "Otto" and Langen engine, introduced some years after, reduced the consumption of gas down to 1850 litres, or 65 cubic feet. A test of the Charon gas motor in 1890 was found to develop 1-horse power with an absorption of 550 litres, or 19·5 cubic feet, of gas. The latest type of "Otto" gas-engine will not consume more than 508 litres, or 18 cubic feet.

We will now compare the relative thermo-dynamic efficiencies of the different gas motors in their historic sequence. Prefacing this comparison by a definition of comparative data, we will accept 270,000 kilogrammes as representing 1-horse power. Dividing this factor by the mechanical equivalent of heat, or 425, we have the figure 635, which represents the number of calories necessary for the production of one actual horse power. If we take 1000 litres of gas to have a calorific value when consumed equal to 5500 calories, the number of litres of gas necessary for the production of 635 calories, or for dynamic energy equal to a horse power, will be equal to

$$\frac{1000 \times 635}{5500} = 116 \text{ litres.}$$

We can now readily compare the thermo-dynamic efficiencies of the epoch-marking gas motors—

No. 1.—(1860) $\frac{116}{2500} \times 100 = 4{\cdot}6$ per cent.

No. 2.—Otto and Langen $\frac{116}{1850} \times 100 = 6{\cdot}2$ per cent.

No. 3.—Otto-Charon (1890) $\frac{113}{550} \times 100 = 21$ per cent.

No. 4.—Otto (British) (1892) $\frac{}{508} \times 100 = 22{\cdot}8$ per cent.

We will compare this last statement of efficiency with that of the highest class of steam-engine, and the value with the average class of steam-engine used by the small manufacturers in Birmingham. It may be accepted that the actual theoretic maximum possible efficiency of the steam-engine is 25·6 per cent.; probably the best engines may realize 15 per cent. A careful test of one fairly high-class steam-engine actually gave 11·1 per cent. of the thermo-dynamic efficiency of the fuel used. The ordinary engines in Birmingham will not realize more than 5 per cent. We recognize, therefore, the *primâ facie* thermo-dynamic advantages of gas motors, especially of the small type, over that of the steam-engine.

Another advantage of the gas-engine is its high ratio of actual to indicative efficiency; and it may be stated that the waste of dynamic power by internal work is less with the gas-engine than in any other motor. The exact loss of internal expenditure may be taken at 21 per cent. The ratio of brake or actual horse power to indicated horse power equals 78·7 per cent. The thermo-dynamic efficiency is, in this instance, 19 per cent. for the indicative, and 15 per cent. for the actual.

In one recent test, the gas consumption was for a brake horse power 693 litres; and the consumption for an indicated horse power equalled 560 litres. The constitution of the gas used was—

	Per Cent.
Carbonic acid (CO_2)	0·5
Carbonic oxide (CO)	4·1
Olefines (C_2H_4 and C_4H_8)	5·5
Marsh gas (CH_4)	43·4
Carburetted hydrogen (CH)	44·1
Nitrogen	2·4
	100·0

The *primâ facie* advantage of gas motors over the steam-engine, distinctive from the thermo-dynamic one, may be thus summarized. It starts almost immediately, without any tedious and laborious preparation. There is no coal to get in, nor ashes or clinkers to clear away. There is no risk of explosion, nor water guages or safety-valves to watch. There are no fires to slack down, nor safety-valves to look after. There is no regular attendance required, beyond oiling, cleaning, and starting.

This appliance has proved to many a struggling small manufacturer, a ladder to fortune; and the distribution of fuel power gas, might with advantage be accompanied with an arrangement by the Corporation of hiring out small gas-engines, either on the easy repayment sale system or on special hire, by a charge on the gas. Thus, might be made a highly

lucrative addition to the revenues of the Corporation. Special artizans might be employed to maintain the gas-engines in a condition of efficiency, and train the users, and report on the manner of working of the gas-engine. The author is informed that several of the large gas-engine makers supply gas-engines on the easy repayment system. One well-known firm in Manchester have an admirable system of hire purchase. The terms are, one-third cash with engine, and the balance extending over eighteen months in equal payments as may be agreed. It would, however, be much more satisfactory if, along with gas cooking-stoves, domestic fires, &c., corporations would supply gas-engines up to moderate powers.

M. Aimé Witz, of Lille, states that the cheaper gas supplied in Germany has greatly facilitated the popularization and use of gas-engines—much more so than in France. The supply of power gas at not more than an average of 1s. 3d. per 1000 cubic feet should, along with the hire system proposed, bring gas-engines into general use—at all events, in the area of power-gas supply.

The distribution of power gas would make electric lighting almost as economically effected as with gas lighting; because, although *primâ facie*, as the author has already pointed out in the JOURNAL OF GAS LIGHTING,* the electric light in the incandescent form generated from fuel power can never be produced as cheaply as gas lighting, especially if the latter is recuperatively effected, there is no doubt but that it will be produced by the system named in some near measure so as to produce the electric incandescent light as cheaply as gas, for a given photometric value. In producing and applying electric energy for lighting, we have the following initial losses—

	Per Cent.
Gas motors	75
Dynamo	10
Resistance	5
Total	90

Or nine-tenths greater initial energy is required than with light from direct combustion. But with incandescent electric lighting, there is not so much external energy wasted as in the gas-light for a given lighting energy. This can easily be proved by placing the hand near an incandescent lamp of a given voltage, and then near to or over a gas-light of equivalent photometric value or candle power. It will be noticed that the loss of radiation and by the thermic waste, as sensible heat, in the products of combustion, is enormously exceeded in the gas-light; so that, although there is the initial drawback of 90 per cent. loss of thermo-dynamic energy, and *pari passu* thermo-luminous energy, against the electric light, the efficiency of the electric light at the luminous point is greater than in the gas-light, which loses great lighting energy by the waste of heat in radiation and as sensible heat. Actual calorimetric comparative tests confirm this statement. In the best recuperative gas-lamps, and in the incandescent gas-lamps of the Welsbach type, this loss is, however, very much reduced. The advantage of the fuel-gas power in popularizing electric lighting and other applications of electricity, will, the author thinks, be now realized. It will, however, be interesting and instructive to compare the thermo-luminous efficiency of gas burnt direct at the gas-burner, and also burnt in a modern gas motor; the dynamic energy produced being afterwards converted into luminous energy, thus—

Thermo-dynamic Transformation.	Dynamic Electro-Transformation.	Electro-Luminous Transformation.
Gas Motor ..	Dynamo ..	Incandescent Electric Light.

For the comparison, a lighting power equivalent to 510 16-candle lights is assumed to be burning for a period of one hour. The electric light equipment consists of an efficient gas-motor; the insulation of the leads is fairly perfect, and they show a loss of only 2 per cent. The dynamo is assumed to realize 75 per cent. of the dynamic power supplied to it.

Summary.

510 incandescent carbon filaments *in vacuo* lamps, each of 60 watts, or (say) equivalent to 16 candles	=	30,600 watts
Loss in leads	=	31,300 ,,
To compensate for 75 per cent. of efficiency, or a loss of 25 per cent.	=	39,100 ,,

Assuming this watt output to absorb 52·6 indicated horse power, then, accepting 20 cubic feet per indicated horse power, the consumption of gas per hour equals $52{\cdot}6 \times 20 = 1052$ cubic feet. Then the number of candles of photometric value obtained per cubic foot of gas burning one hour, would be equal to $(510 \times 16) \div 1052 = 7{\cdot}7$ *candles per cubic foot of gas burnt in the gas-motor cylinder.* Ordinary 16-candle gas burning at the rate of 5 cubic feet per hour will give an open-flame light of a luminous value of 12 candles. Hence $12 \div 5 = 2{\cdot}4$ candles per cubic foot per hour. An inverted recuperative gas-lamp will give, with a consumption of 5 cubic feet per hour, a light equal to 40 candles. Then $40 \div 5 = 8$ candles per cubic foot per hour. And an incandescent gas-lamp of the latest improved form may be taken to give, with the same consumption of gas, a light equal to 50 candles—then $50 \div 5 = 10$ candles per cubic foot per hour. Taking the consumption of gas test *per se*, upon which to base comparisons of efficiency, it will be seen that the consumption of gas in an efficient gas-motor cylinder, with a carefully arranged electric light equipment, offers an economic advantage in comparison with naked-flame gas-lights.

* See Vol. XLVII., p. 17.

In the event of fogs, the gas-engine can be started instantly, and almost in the time the author is writing this paragraph, the electric lighting energy is at the disposal of the user; so that in almost every sense, the use of the gas power would be highly advantageous, and would be a fitting handmaid in the service of man, in the economic distribution of electric, thermic, and dynamic energy.

The author has demonstrated, in various articles, that the cause of our increasingly dangerous and dense smoke fogs is due to the imperfectly consumed hydrocarbons of bituminous coals. The absolute cure for this curse of English city and town life is the use of fuel gas; and this apology is alone sufficient, as it includes the removal of all those barriers to Nature's sustaining and vitalizing influences on mankind. The smoke of towns cuts off the actinic rays of light, lowers the animal temperature, and enervates and reduces animal vitality. The gas fuel application would remove a great part of this evil, which is at once the disgrace and danger of modern civilization.

It is well known that, whilst we are ransacking foreign countries for agricultural fertilizers, we have in the nitrogenous constituents of our fuel resources, a quite sufficient storeage of agricultural fertilizers; but in our present method of consuming coals, all the fertilizing wealth is deliberately and wantonly thrown away. The conversion of the solid fuel coal into a gaseous condition enables the recovery (if not synthetical formation) of the nitrogenous agricultural fertilizers to be easily effected. It is generally accepted that 25 lbs. of sulphate of ammonia may be recovered from one ton of bituminous coal. But it is stated, with some reason, that under certain specific conditions of manufacture, as much as 70 to 80 lbs. of sulphate of ammonia per ton of coal gasified can be obtained. Whether this is so or not is unimportant; suffice it to say that the nitrogenous and other residuals of gas manufacture have enabled gas manufacturing firms to realize most substantial financial advantages; and all solid fuel of the bituminous class, so converted, offers similar facilities.

Even with the comparatively high prices charged for gas, its value as a fuel or heating agent has become widely appreciated—especially by the classes to whom the financial question is of minor importance. The following list, long as it is, gives an imperfect idea of the area filled by gas fuel: For motive power—gas-engines for all operations requiring dynamic energy, and especially available for application of electric energy generated in well-distributed stations, by which the use of expensive storeage batteries will be avoided. For industrial purposes—welding, soldering, brazing, forging, fusing, baking, roasting, boiling, tin-work, melting, blow-pipe, muffle heating, and dentists' and laboratory work. For domestic and associated purposes—cooking, coffee-roasting, drying clothes, frying, instantaneous water heating, smoothing-iron heating, toasting and grilling, plate drying, heating tailors' irons, heating, washing, and laundry work. By the employment of modern gas-fires, nearly all the pleasures so typically English of the open fire, can be obtained without the accompanying dirt, trouble in the lighting, maintenance, or regulation, and other inconveniences; and by the use of recuperator gas-fires, and the low-price fuel gas supplied, no householder need pay more for his gas-heating convenience in London than it costs him for coal used in the usual wasteful manner, not to mention the saving of domestic labour in washing, the deterioration of furniture, curtains, &c. It has been proved that a dinner can be cooked for a very large family for a little more than 1d.

Hygienically, the open gas-fire, in which there is no exposed horizontal iron surfaces upon which the organic matter in the air can settle and become cremated, is all that can be desired from the point of economy and efficiency; and special apparatus can be supplied to enable any temperature for invalid purposes to be maintained, and by which ventilation can also be adequately and properly secured.

Referring to the paragraphs in which it was demonstrated that there is no advantage in distributing high and expensive photometric gas for heating purposes, this fact is further accentuated by the statement that ordinary English gas coal, economically distilled, cannot be said to produce gas of a higher luminous value than is indicated by 14·74 sperm candles. To obtain a higher photometric standard involves either an economic method of distillation, or resource to expensive cannel coals, which adds, for every candle of additional photometric value power per 1000 cubic feet, above 14·75 candles, from ¾d. to 1¼d. above the average cost of the gas. The ratio of the measure of this addition, therefore, has to be added to the measure of advantage of supplying low candle gas for power and fuel purposes.

Let us assume that the Birmingham power and fuel gas is composed of a mixture of the standard 17·4-candle gas, and a non-luminous but purified generator gas, proportional in such a measure as to produce 12-candle gas. The purified generator gas can be produced from bituminous coal at 4d. per 1000 feet. The statutory 17·40-candle power gas would have to be diluted with 620 feet of generator gas; so that the cost of 1620 cubic feet of 12-candle gas can be taken as equal to 2s. 2·8d. × 2·48d. = 2s. 0·76d., or equivalent to 1s. 6d. per 1000 cubic feet. This price allows approximately of a gross profit of 8·969d. per 1000 cubic feet to be realized. The price might therefore be reduced by 2d.; leaving the gas to cost 1s. 4d. per 1000 cubic feet. The gas would have a thermic value of (say) 686 British thermal

units per cubic foot. Were the gas distributed with a candle power value of 10·5 candles, the cost would be profitably fixed at 1s. 2d. per 1000 cubic feet. The cost of an actually available brake horse power taking 28 cubic feet per indicated horse power, and deducting 21 per cent. for internal work, may be calculated to equal 0·474d. per brake horse power per hour, or less than ½d., against 6d. the cost of hydraulic power. With the 12-candle power gas, taking 24 cubic feet per indicated horse power, the cost of 1 brake horse power per hour will equal 0·52d., or rather more than ½d., or about one-fourth the equivalent cost of hydraulic energy.

A fuel generator gas could be produced of a non-luminous character from coke or anthracite, and of a slightly luminous value from slack coal, at a less cost than the 10-candle gas proposed; and by its compression equivalent to from 4 to 8 inches of water, practically the same heating power could be passed through the mains as with lighting gas.

When it is realized that the thermic value of the gas obtained from one ton of coal distilled in ordinary retorts is only some 6 millions of British thermal units, and that there is a balance remaining of some 15 to 19 millions of British thermal units residual in the coke, it will be easily realized that this residual value might be more economically distributed to the consumer. From ¾ lb. of anthracite, 1 lb. of slack coal, and 1¼ lbs. of good coke, fuel gas can be generated that will develop 1 indicated horse power. If we take it that 1 cubic foot of anthracite or coke gas has a thermal value of 165 and 145 units respectively, then 4 cubic feet are equal to 1 cubic foot of town's gas.

Now estimating a production of 125,000 cubic feet of generator gas per ton of anthracite, costing 10s., this is practically equivalent to 1d. per 1000 cubic feet, and taking the cost of labour and purification, and interest on plant, at 1½d. per 1000 cubic feet, multiplying by the thermal value ratio to that of coal gas $\frac{660}{165}$, gives the equivalent value of anthracite generator gas at 9d.; and the equivalent value of coke generator gas equals 11¼d. So that the non-luminous gas could be sent to the consumer at a less cost than the 10-candle gas for an equivalent fuel value. Generator gas, produced from ordinary bituminous coal, may be taken to give an average thermic value of 180 British thermal units; and the cost of this coal only slightly exceeds 9s. But assume the cost to be 10s., and the labour of purification and maintenance to cost 1⅝d. per 1000 cubic feet, then the cost of the slack coal gas to give an equivalent thermal value to town gas will be as $\frac{660}{180} \times 2\frac{5}{8} = 9{\cdot}6$d. per 1000 cubic feet. So that it appears that the balance of advantage is between anthracite and slack coal; and in nine cases out of ten, the low cost of the slack coal would decide the economic question in favour of the latter fuel. Fuel and power gas generated from either of the solid fuels mentioned, can be distributed under a slight pressure at a less cost than the 10-candle power gas so as to give an equivalent thermic value.

One advantage possessed by the generator gas is the fact that the labour factor of cost in proportion to the volume of gas produced is less than that associated with retort gas. The feeding of the fuel can be effected automatically. It has already been stated that, on a small scale, fuel gas generated from anthracite coal has driven gas-engines at a cost in fuel of less than 1 lb. per indicated horse power—thus far-and-away surpassing any contemporary work in other fields of thermo-dynamics; and this generator gas, but for its characteristic non-luminosity and practical inodorousness, is the *beau-ideal* fuel. The generator gas produced from slack coal has its own generic odour, and is slightly luminous. A calorimetric test of this gas has indicated 220 British thermal units per cubic foot. It is, however, altogether inadequately luminous for lighting purposes; and it is considered by the author that 10-candle gas, although exclusively a heating gas of a satisfactory distributing character, is also a luminous one, and better, in fact, than the natural gas of Pennsylvania, and which is used for heat, power, and light.

The 10-candle power gas approaches very closely in character to the American natural gas, both thermically and chemico-constitutionally. It is very easy to burn the gas economically, whereas the rich hydrocarbons of the high candle power gas are far more difficult to consume. With this rich gas, the nice and adequate proportion of air to oxidize the combustible elements is more difficult to effect; and the result is generally incomplete combustion, and consequent thermal waste. It is far more advisable to contribute an excess of air to support combustion, and lose by abstraction of an excess of sensible heat in the products of combustion, than to lose imperfectly consumed gases having unexhausted thermo-chemical energy.

The 10 or 12 candle power gas is thus a fuel that will be found economical to use both as a heating and power agent, besides being conveniently luminous. It must, however, be understood that the author does not recommend low-candle gas for all lighting purposes. Where enriching agents can be cheaply obtained, it is more economical, and a higher thermo-luminous or lighting efficiency can be obtained, with a high proportion of a condensed character of hydrocarbons in the flame; and the higher the candle power, within certain limits, the better. *

* "On Luminous and Non-Luminous Combustion." By B. H. Thwaite. See JOURNAL OF GAS LIGHTING, 1891.

It follows, therefore, that to effect the introduction of an economical gas for power and fuel purposes: First, it should have a photometric value of 10 or 12 candles. Second, in order that the gas shall be distributed without involving large diameter and consequently expensive mains, the gas shall be distributed under a pressure equivalent to from 4 to 16 inches of water. Third, to encourage the use of gas motors felicitous arrangements of hiring or easy hire payment systems should be started to gradually introduce the gas for domestic heating systems. Fourth, to effect the most desirable conditions, will involve the employment of special high-pressure mains and special gas compression plant.

The Birmingham Corporation can initiate the distribution of fuel and power gas system, and establish its advantages in the following manner: First, by taking over the distributing-mains of the late Birmingham Compressed-Air Company. Second, by utilizing the present compression plant of the same Company. Third, by establishing fuel-gas generator plants to produce fuel gas from coke, anthracite, or bituminous slack coal, as may be found most economical, to mix with the ordinary standard candle power retort coal gas. Fourth, by establishing three or more small storeage holders of (say) 5000 cubic feet each capacity for mixing the generator gas with the town's gas, and equipped with suitable valves and connections. And fifth, by the encouragement of the use of the gas fuel in various ways in different parts of the area served by the present mains.

The effect of such applications will result eventually in the general demand for the fuel and the power gas; and Birmingham —once the supply is extended to feed the entire town—will place herself in the foremost rank amongst the municipalities of England. Her sky will be unclouded by the hideous pall of smoke; unsullied will in future be her architectural creations; her industrious townsmen will have power and fuel advantages unexcelled; and her housewives will have a domestic expedient that will reduce the labours and expense of home, and add to its comfort and cleanliness. Then, why should Birmingham wait?

Report of Mr. Dugald Clerk, C.E., F.C.S.

I have read, and carefully considered, Mr. B. H. Thwaite's able and admirable paper on this subject; and I am quite at one with him as to the desirability of the introduction on a considerable scale of a separate motive power and fuel gas in our large industrial centres.

Birmingham is an admirable district in which to make a beginning; and the plant of the Birmingham Compressed-Air Company seems to me to offer a most favourable opportunity for a thorough large-scale test under conditions of first cost which ensure financial success. While at one with Mr. Thwaite on this point, I would, however, say that, in laying down new mains and plant for the supply of power and fuel gas, the cost of the mains and plant could bear no relation whatever to the enormous expenditure of the Compressed-Air Company. Mains of a very inexpensive kind, and gas generating and distributing plant of a simple nature, involving the use of a trifling amount of motive power only, are required. The large air-compressing pumps and engines of the Company are not required for a thoroughly effective fuel gas scheme, as the pressure of fuel gas in the mains need not exceed 6 inches of water. Mains to withstand, and pumps to compress to 50 lbs. per square inch are therefore unnecessary. But the fact of the existence of those engines, pumps, and mains puts it in the power of the Birmingham Corporation to make a departure in the supply of motive power and fuel gas without delay, and at a trifling outlay; and, in my opinion, Birmingham should take up the matter as a beginning to the wholesale distribution of power and fuel gas throughout all the manufacturing districts of the town.

In one of his British Association addresses, the late Sir W. Siemens strongly advocated the production and distribution of a separate fuel and motive power gas in our large centres; and this at a time when the gas-engine had not attained the high development of to-day. I have long agreed with this distinguished pioneer in the application of gas to industrial purposes; and it appears to me that the time has now come when such a scheme could be put into practice with certainty of financial success. Gas-engines are now manufactured and sold, by many excellent engineering firms throughout the country, at prices which compare favourably with those of steam-engines; and it only requires the production and distribution of a cheap power and fuel gas to at once bring gas-engines into use for the largest as well as the smaller powers. The commercial advantages of such a proceeding are very obvious; and the city or town which first adopts a power gas scheme will undoubtedly reap a substantial reward, and secure great commercial benefits for its industries.

In my opinion, a good fuel and motive power gas could be manufactured and distributed at a profit at a charge to the consumer of 1s. per equivalent of 1000 cubic feet of ordinary lighting gas. This would mean that, in a gas-engine of moderate power—about 8-horse indicated—the cost of gaseous fuel would only be ½d. per indicated horse power per hour. That is, the 8-horse power engine could be worked at full power for 2d. per hour, or considerably less than one-half of the cost of gas power with ordinary illuminating gas as at present used in Birmingham. Such a gas need not be of high illuminating power, but would only be enriched with such a proportion of hydro-

carbon as would give it an odour similar to ordinary coal gas. The odour of coal gas, much as people object to it at times, is a primary necessity for its safe use. Without the odour, coal gas could never have been safely used on the enormous scale which it at present rules. High illuminating power, however, is quite unnecessary; and by dispensing with the greater proportion of the illuminating power, the gas may be manufactured at a very cheap rate, and the whole of the coal may be converted into gas, and the production of coke avoided. At the same time, much cheaper coal could be used than is at present found to be necessary.

I do not doubt but that power gas can be sold at a much lower figure than 1s. per equivalent of 1000 cubic feet of ordinary lighting gas, when the system of production and distribution is conducted on a sufficiently large scale. But at present there seems to me to be no barrier to its immediate production and distribution at that sum on the comparatively small scale allowed by the use of the Compressed-Air Company's mains.

The power gas could be used for many purposes other than power; and for many industrial and domestic uses it would effect a large saving, not only in cost of fuel but in absence of the dust and smoke so common to our ordinary fires.

For all furnace work in brass and metal founding operations, it could be used with great advantage, in ease of manipulation and saving of fuel. For gas welding, it would receive an extensive and increasing application.

The distribution of motive power by inflammable gas is by far the most economical system at present known; and it is incomparably better than any compressed-air or high-pressure water scheme. Compressed air, as used in many mines throughout the country, does not return more than 25 per cent. of the power expended in producing it; while, under similar conditions, gas will return 99·9 per cent. of the power with which it starts on its journey of distribution.

Hydraulic power at high pressure, although most valuable for hydraulic lifts and other similar purposes, is far too expensive for ordinary motive power. Indeed, at the scale charged by the London Hydraulic Power Company, power costs 4d. per horse power per hour.

Taking all these matters into consideration, I am of opinion that a fuel gas scheme for Birmingham is thoroughly practicable, and, if properly carried out, would greatly aid Birmingham manufacturers in their competition with other districts, by effecting a large saving on the present expenditure for fuel and motive power, while tending to solve the smoke problem which is so distressing in our cities.

The Gas Industry before the Labour Commission.—Most of our readers will be interested to learn that the complete evidence in connection with the gas industry given before the Labour Commission is now published by Messrs. Eyre and Spottiswoode. It occupied four days (the 29th to the 32nd) of Committee C; and the price of the report of each day's proceedings is 2d. In view of the value to gas managers generally of the evidence presented, it has been suggested that they should obtain copies of the papers, and have them bound in a volume for present use and future reference.

Presentation to Mr. R. Sharpe.—The occasion of the marriage of Mr. R. Sharpe, Assistant-Manager at the Belfast Corporation Gas-Works, was selected by the workmen as a suitable one for presenting him and Mrs. Sharpe with a testimonial expressive of their respect and esteem. It consisted of a silver tea and coffee service, suitably inscribed, and placed upon a silver-mounted oak tray bearing their monogram. The presentation was made privately; and it was accompanied by an address setting forth that it was the spontaneous offering of those who had for a long time appreciated his fair-minded dealing between them and their employers. Mr. Sharpe, in acknowledging the gift on behalf of Mrs. Sharpe and himself, assured the donors of it that he reciprocated the kindly feeling they had so handsomely expressed.

Presentation to the Chairman of the Slough Gas Company.—At a meeting of the Board of this Company, on Monday last week, Mr. R. Martin, the Chairman, was presented with an address in commemoration of the 25th year of his chairmanship and the laying of the foundation-stone of the alterations which are about to be carried out at the works. A comprehensive address, giving a *résumé* of these and previous improvements, was read by the Vice-Chairman (Mr. E. Herbert), who added a few remarks confirming the interesting details enumerated. Mr. Martin, in accepting the address, gave an interesting account of the difficulties and trials experienced during his chairmanship; and feelingly alluded to the decease of all the Directors and officials associated with him in the earlier part of his connection with the Company. He also referred, with satisfaction, to the sound and efficient condition of the works during the past decade, and said he would endeavour, with the co-operation of the other Directors, to continue to maintain the works in their present same high state of efficiency. The stone was then laid by Mr. Martin. Subsequently, the Secretary, Mr. A. Thomas, presented a trowel, suitably inscribed, to the Chairman, and made some well-chosen allusions to the occasion. Mr. Martin appropriately acknowledged the gift.

TECHNICAL RECORD.

ESTIMATION OF SULPHUR IN COAL GAS.

At a recent Meeting of the Yorkshire Section of the Society of Chemical Industry, Mr. T. FAIRLEY, F.R.S.E., F.I.C., the Gas Examiner for Leeds, read a paper on the above subject. It gave the author's further experience of a method of gas analysis proposed in a communication submitted by him to the Manchester Section of the Society in 1886, the full text of which appeared in our columns at the time.* In that paper, Mr. Fairley gave a *résumé* of the methods hitherto used for the estimation of sulphur in gas; and on the present occasion he exhibited the Referees' apparatus for testing for this impurity.

In place of the solid ammonium carbonate round the burner in this apparatus, Mr. Fairley proposes the use of a dilute solution of hydrogen dioxide, run in through a capillary tube at the rate of about 3 c.c. per hour at the top of the condenser. The sulphur dioxide is completely oxidized into sulphuric acid, and may be determined by titration with standard alkali. If the solution of sodium hydrate used contains 0·25 grain or 0·0162 gramme per cubic centimetre, the number of cubic centimetres of standard sodium hydrate give without calculation the number of grains of sulphur per 100 cubic feet of gas, when 10 cubic feet of gas are burnt. There should always be a slight excess of hydrogen dioxide in the condensed liquid, so as to secure complete oxidation of the sulphur. He does not advise the use of standard ammonia in this titration, as higher results are obtained when this alkali is used; the dioxide apparently tending to assume the part of an acid. If such an excess of dioxide is present as to interfere with the use of litmus or other indicator, the liquid may be evaporated to dryness in a small bulk with an excess of standard soda, and the excess of alkali titrated with standard acid. The dioxide must be carefully tested for impurities, especially sulphuric acid or barium salts. The gas, before burning, should be as completely freed as possible from ammonia, by passing through a saturator containing a large excess of sulphuric acid. Minute quantities of nitric acid are sometimes found in the condensed liquid—probably formed by the oxidation of ammonia or other nitrogen compound left in the gas. Mr. Fairley has not found this circumstance to practically interfere with the use of the process.

As compared with the ammonium carbonate process, the use of hydrogen dioxide has two other advantages: The reagent is supplied at a uniform rate throughout the experiment, whereas with ammonium carbonate there is a large excess of ammonia at the beginning of an experiment, followed by a possible deficiency before the 20 hours (required for a 10 cubic feet combustion) have expired. There are no solid products, such as ammonium sulphate, formed in the chimney or condenser. The apparatus may therefore be used continually for days together, and a true average of the sulphur contained in the gas supplied at all times obtained by simply analyzing a fractional part of the condensed liquid, without washing out the apparatus. This is specially valuable in a gas-works, where it is desired to constantly test the gas as it is made. Under ordinary circumstances, a continuous test of the gas as supplied to consumers would give an undue preponderance to the gas supplied during the day, as the sampling would be taken from a smaller consumption. The numbers obtained by the use of hydrogen dioxide generally give from one to two grains of sulphur per 100 cubic feet of gas more than is obtained by the use of ammonium carbonate. Out of a large number of tests, the author quoted the following:—

Ammonium Carbonate by Precipitation with Barium Chloride.		Hydrogen Dioxide by Precipitation with Barium Chloride or by Titration as above.
13·40	..	15·73 by precipitation. 15·42 by titration.
13·30	..	15·43 " "
13·27	..	14·74 by precipitation.
12·89	..	14·00 " "
12·31	..	14·31 " "

Mr. Fairley has also devised an apparatus for the continuous testing of gas for carbon dioxide and ammonia. He exhibited it to his audience, and promised to bring before the Society the results obtained by its use.

In the discussion upon the paper, the Chairman (Mr. G. Ward) inquired if he had rightly understood the author to say that the Referees' process for testing for sulphur in coal gas only estimated half the impurity present. He also wished to know if Mr. Fairley had ascertained, by his process, that any of the atmospheric nitrogen was oxidized into nitric or nitrous acids by the hydrogen peroxide employed. It would, he said, be very convenient if the sulphuric acid produced could be estimated by the specific gravity of the solutions. Dr. Lewkowitsch said that in some experiments he had had occasion to make on crude German petroleum, the bad qualities of which were ascribed to sulphur, he first used a process in which the petroleum was burned, and the sulphur oxidized in the wet way by a solution of bromine in hydrochloric acid; but he afterwards adopted a method proposed by Victor Meyer for the determination of sulphur in thiophen. As Mr. Fairley

* See Vol. XLVII., p. 1102.

wished to put a convenient method into the hands of gas managers, was it possible so to regulate the combustion of the sulphur that the whole might be burnt into sulphur dioxide, and then estimated by its action on iodine solution? Professor Tilden said it was interesting to see how faithfully Mr. Fairley stuck to his favourite reagent—hydrogen peroxide. With regard to the possibility of so burning sulphur that sulphur dioxide only should be produced, a proportion of sulphuric acid always resulted when sulphur was burnt in the presence of aqueous vapour. In evaporating water in a basin covered with filter-paper over an ordinary Bunsen burner, it was often found that the surface of the paper was charred—not with the heat, but by the action of the sulphuric acid evolved. Mr. S. C. Lupton said that, in the early days of the Referees' process, he had made, under Mr. Vernon Harcourt's direction, a few experiments with the object of obtaining a more simple method. Attempts to oxidize the sulphur in the gas in the wet way, by passing it through a hot acid solution of potassium dichromate or chlorate, contained in a Brodie's tube, failed from the liability of the liquid to project from the tube. The converse method of reduction proposed by Mr. Harcourt, promised much better results. If gas free from hydrogen sulphide were passed through a red-hot tube packed with broken porcelain, a fairly regular proportion, though possibly not the whole of the sulphur, would be converted into hydrogen sulphide. This might be absorbed by an alkaline solution of lead nearly saturated with sugar (which retarded the formation of a precipitate), and estimated colorimetrically. Mr. H. R. Procter alluded to the injurious action upon leather of the sulphuric acid produced by the combustion of gas; and he mentioned a case in which he actually found 1·5 per cent. of free sulphuric acid in leather which had been destroyed in this way. Mr. Fairley, in reply, said that the sulphur converted into sulphuric acid by combustion in an ordinary or Bunsen gas-burner varied from one-half to one-tenth of the total; but the product was always a mixture of sulphurous and sulphuric acids. Specific gravity could not be used, in place of titration, to determine the amount of sulphuric acid produced, since the variation due to the acid was small compared with that caused by changes of the temperature. The temperature of the air had also some influence on the amount of water condensed with the acid. Oxides of nitrogen were found in the products of combustion of the gas; but they might be due to presence of traces of ammonia which purification had failed to remove.

NITROGEN IN COAL GAS.

In the JOURNAL last week, we gave the principal portions of the paper on the "Estimation of Nitrogen in Coal Gas," read by Mr. C. H. New at a recent meeting of the Manchester Section of the Society of Chemical Industry, with an abstract report of the discussion thereon, from the *Journal* of the Society. The current number of that publication contains some "Notes" by Mr. G. E. Davis, which were submitted at a subsequent meeting; and we reproduce them as supplementing what has already appeared.

Mr. Davis begins by referring to the doubts expressed in the course of the discussion on Mr. New's paper, as to whether so large an amount as 14 per cent. of nitrogen could possibly exist in a gas supply, seeing that Professor Vivian B. Lewes had examined a sample of London gas which contained less than 1 per cent. It will be remembered that it was pointed out by Mr. Stenhouse that if 1 per cent. of nitrogen were present, due to the pumping in of air, there should be, at least, 2 per cent. of free oxygen, the presence of which the reader of the paper had not recorded. Mr. Davis then continues: I saw that the argument used by Mr. Stenhouse would at once prove the accuracy or otherwise of Mr. New's results; and on Saturday, May 7, the day after the reading of the paper, I decided to make an examination of the gas for oxygen, nitrogen, and illuminating power, concurrently. At 10 a.m., and when it might be supposed that the night gas lay dormant in the pipes, I found the gas contained 1·1 per cent. of oxygen; and its illuminating power was 15·6 candles. At 12.30, after the gas had been burning the whole interval in the laboratory, tests were again made, with the following results: Oxygen, 2·1 per cent.; nitrogen, 13·9 per cent.; illuminating power, 13·6 candles. I think this shows clearly enough that there is a difference between the night gas and the day gas, and that the difference in illuminating power is chiefly due to oxygen and nitrogen. Why this is so, I do not pretend to explain. I have made some further tests with reference to the percentage of nitrogen. The day tests on the 18th inst. were 8·28 per cent. of nitrogen with 1·08 per cent. of oxygen. On the 23rd of May the day gas contained 8·67 per cent. of nitrogen; the night tests containing less nitrogen. On the 16th, taken at 8 p.m., the percentage of nitrogen was 7·3; on the 17th it was 7·4, with 1·5 per cent. of oxygen; on the 19th, at 7.30 p.m., it contained 5·6 per cent. of nitrogen; on the 20th, at 10.30 p.m., it contained 7·4 per cent. of nitrogen; and on the 22nd, at 8 p.m., it contained 7·75 per cent. Between the 16th and 23rd the illuminating power varied from 13·2 candles in the daytime to 15·6 candles at night. Compared with Professor Lewes's figures for the London gas, we appear to have a very different mixture in Salford; and the low illuminating power as recorded upon our photometer is clearly explained. How this nitrogen and oxygen get into the gas is a matter I have not considered; and these facts seem to be borne out by some further figures from Professor Lewes. He finds that 100 volumes of gas require about 230 volumes of either air or nitrogen to reduce its luminosity to *nil*—a quantity which certainly does not agree with the earlier notions of gas engineers. In the Salford gas there exists at the utmost 14 volumes, and as a general thing, 7 to 8 volumes, which is about the proportion necessary to reduce the illuminating power from 18 to 14 candles, if reckoned as a diluent, combined with a certain amount of light-destroying power. Mr. Hunter, in his lecture at Salford in 1878, states that 10 per cent. of air added to 25-candle gas reduced its illuminating power to 8·25 candles. Under extraordinary conditions this might be so; but I think I have shown it is possible to have 14 per cent. of nitrogen and 2 per cent. of oxygen in 14-candle gas.

In the discussion to which the presentation of the foregoing "Notes" gave rise, Mr. Stenhouse said that, after hearing Mr. Davis's previous paper, and that by Mr. New, he obtained two samples of gas, and very carefully determined the amount of oxygen—finding 0·6 per cent. in each sample. If there was oxygen in the gas, there must be air present; and there could not be a large quantity of nitrogen in the gas without there being a corresponding quantity of oxygen. Such a large percentage of nitrogen was very remarkable, especially from the gas of Salford, where it was very carefully made, and where there would be no means of air rushing in without its being known. If they did pass air in, they would only use just sufficient to revivify the purifiers, whether oxide of iron or lime were used. With this end in view, it would be folly to add more than 4 or 5 per cent. altogether; because 0·5 per cent. of air could not possibly be taken up by partly fouled oxide. It might be said they made very good gas at Salford, and then reduced its illuminating power by passing air into it. But this would be a very expensive process; and if Mr. Davis's figures were correct (of which there could scarcely be any doubt), it would appear that a large quantity of air was being passed into the gas. Mr. Davis seemed to have found a considerable amount of nitrogen in the morning. It was difficult to understand why there should be more then than at night; for if they had to send air in, it would be in regular quantities, and it would be impossible to say into which of the holders it had passed. Mr. Duncan asked if the nitrogen might not have found its way in by diffusion. Mr. Carpenter said he remembered it once being suggested that every gas manufacturer who proposed to put air in his gas should carefully measure it; but it was quite possible that air might get into the gas through cracked retorts. Mr. Stenhouse remarked that that would be an isolated case; whereas Mr. Davis had quoted many instances. Mr. Davis, in reply, said he could not see why it would be foolish to put air into gas, so long as the consumers were prepared to accept a mixture of gas and air. It was an undoubted fact that gas had a low illuminating power at certain times of the day; and it was also undoubted that the tests proved the presence of air. But whether it got there by diffusion through the pipes or joints, as suggested by Mr. Duncan, he was not prepared to say.

AN EXPERIENCE OF GASHOLDER TANK CONSTRUCTION.

In a paper prepared by Mr. A. P. Boller for presentation at the last annual meeting of the American Society of Civil Engineers, he treats of foundation work undertaken upon differing, and somewhat difficult, conditions. In one case the author was engaged as contractor in the construction of gasholder-tanks for the Bay State Gas Company of Boston, whose plant is situated at Dorchester Bay, near the pumping-station of the main drainage works of the city, and is erected on what was originally marsh land, flooded at high tides from the bay. According to an abstract of the paper which appeared in a recent number of the *Engineering Record*, the contract was for two brick tanks, about 30 feet apart, each having an inside clear diameter of 152 feet, with foundation footings sunk about 80 feet below the level of the marsh. By the terms of the contract, the contractor was to do his own engineering and inspection in accordance with the plans furnished; the principal requirement being that the tanks should be guaranteed water-tight and circumferentially true. The material used was hard-burnt Eastern brick laid in improved Union cement, and coarse gravel concrete made with Portland cement. No borings had been made on the site of the tanks; but it was assumed that the material to be gone through was substantially of the same character as that met with at the pumping-station 500 feet distant, where considerable difficulty was encountered; the marsh mud at that particular place having under it clay and a water-bearing sand.

The mode of construction adopted was as follows: The site of the tanks and the gas-making plant, covering something like 2 acres of ground, was first dyked off from the sea, which flooded the marsh at high tide. Between the tanks a sump-hole 10 feet square was sunk and planked up, into which all drainage was to be carried. The pumping plant consisted of two 80-horse

power locomotive boilers, and four centrifugal pumps (two 6-inch and two 8-inch discharge), forming a duplicate plant; it being expected that one of each size pump would be amply sufficient to deal with the water under the plan of construction adopted—the other set being held in reserve in case of accident. In sinking the sump, much difficulty was experienced from marsh gas about two-thirds of the way down; and a blower plant had to be put in service (to dilute and dissipate the gas) before work could be advanced to the bottom of the sump. The walls of the tanks were built in excavations precisely as if a circular sewer was intended; the interior cone being left for excavation after the completion of the walls. The wall excavation was sloped about 1 to 1 for 10 feet, when sheet piling was introduced —4 inches tongued and grooved for the outside row, and 2 inches for the inner row. The sheeting was mauled down as far as possible, when a small steam pile-driver was used to drive it below the concrete footing. This was an easily-handled machine, consisting of a single square timber mast on the apex of a triangular base; the 500-lb. hammer being grooved to slide over a T-rail guide secured to the mast. The excavations were carried from the sump drains; and the sections varied in length as contention with water dictated. This manner of putting in the tank walls required only a narrow excavation easily braced; and it reduced to a minimum the demand on the pumps. In building the brickwork, to secure tightness the band was broken as irregularly as possible in the hearting of the wall, and to ensure a thorough filling of the joints with mortar, the bricklayers were instructed to keep their fingers over the bricks, and lay them a finger width apart. Each course of brick was thoroughly grouted as the work progressed. As the wall was built up, the outside void formed by the excavation was refilled with the excavated material and well rammed. The circular alignment was maintained and vertically ensured by frequent checks with a standardized steel ribbon revolved round a carefully maintained centre peg, and plumbing done from the end of the radius. This resulted in such accurate work, that little or no furring was required for setting the gasholder guides; and a trifling amount of cutting into brick was required in only a few cases. On the completion of the walls, the central cone was rapidly excavated, and the concrete bottom was put in without much difficulty, except for about one-third of the length near the footings of one of the tanks, which was conquered section by section with sheeting and boxing in a continuous drain below the concrete. The water difficulty was not so great as was anticipated. Almost all the excavation, after passing the marsh mud, was in clay; and intermittent pumping kept the work free of water. After the tanks were filled to their capacity, no appreciable loss from No. 1, and losses of 4 to 5 inches only from No. 2 were reported, with a rate of improvement which indicated an entire stoppage of the water in a few days.

REGISTER OF PATENTS.

Gas-Engines.—Day, J., of Bath. No. 6410; April 14, 1891.

This invention refers to gas-engines of the class in which the crank works in an enclosed space in the framework, and an impulse is obtained at every revolution. The plunger or piston reciprocates in the cylinder, which is mounted over, and connected by a connecting-rod to the crank, in the case of a vertical inverted type of engine; and the air and gas are drawn in from below through the casing surrounding the crank during a portion of the up-stroke—being conveyed into the upper part of the cylinder at the beginning of the up-stroke by valves in the plunger itself, or by a suitable channel outside, until the pressure above and below the plunger is equal, whereupon the compression of the mixture begins, owing to the piston-valve closing automatically. The ignition then takes place by any suitable means; and the plunger is forced down until the exhaust-port in the cylinder is uncovered thereby, and the majority of the products of combustion escape. At the same time, a certain amount of compression has been given to the mixture of air and gas below in the enclosed space or chamber, in such manner that, as soon as the exhaust has taken place, the explosive mixture opens the valve in the plunger and passes through. By regulating the size of the exhaust-port in the cylinder, more or less of the products of combustion are left in the cylinder at the end of the down-stroke, as desired.

In order that the explosive mixture may not at the beginning of the up-stroke escape by the exhaust, there is a sort of funnel, shield, or deflector on the top of the plunger or otherwise; and the passage for the valve is arranged in such a manner that the explosive mixture is directed away from the exhaust-port. The cubical contents of the enclosed chamber and cylinder bear such relation to one another that, on the charge being delivered into the cylinder from the lower chamber, both sides of the plunger are at or about atmospheric pressure. The mixing of the air and gas is effected by the agitation caused by the revolution of the crank disc and crank and movement of the connecting-rod; while lubrication, and keeping cool of the several moving parts, are attained by permitting one or more of the parts to move or impinge against oil or water or both in the bottom of the enclosed space. The speed of the engine is governed by means of an ordinary governor acting on the gas supply, or by a valve in the lower enclosed space opening to the outer air, and acting (for instance) similarly to the other gas and air inlet-valve.

Gas-Engines.—Dawson, H. T., of Salcombe. No. 9865; June 10, 1891.

This invention relates more especially to gas-engines in which the piston serves as the valve to admit the gaseous charge to the cylinder, to bring the same into communication with igniting apparatus, and to allow of the escape of the products of combustion—each at the appropriate time, as described in patent No. 6407 of 1890.

The first improvement refers to the way in which the necessary continuous rotary motion of the piston within the cylinder is obtained. This is effected by means of the connecting-rod, and parts in connection therewith. One part of the rod is fitted at one end with the bearing which receives the crank-pin; and at its other end, there is a collar in which an axis forming another part of the connecting-rod is able to rotate. This axis is at one end coupled, by a ball-and-socket joint, with the piston; and at the other end, it is held in a bearing formed in connection with the main or crank-pin bearing. The crank pin has a worm (or else oblique teeth) upon it; and the teeth are in gear with a wheel with corresponding teeth upon the axis, so that it rotates in the collar and bearing as the crank revolves. Near to the ball joint which connects the axis with the piston, the axis has horns clipped upon it; and these project on either side—the horns serving to transmit the rotary motion of the axis to the piston. A semi-circular yoke-piece is jointed to the piston, with pivots at right angles to the axis of the cylinder; and in this yoke-piece, are slots into which the horns are received.

The invention also relates to the construction of the piston and parts in connection therewith. The piston is formed hollow, and is filled with asbestos to lessen the conduction of heat. It is surrounded by a ring, fitted to the cylinder by spring packing-rings around it, confined between flanges or cover-plates on the piston, which allow some freedom in a radial direction. The piston is provided both on its upper and under sides with trunks which have inwardly directed flanges; and by these, they are connected with the piston, but so as to permit a certain amount of freedom, as in the case of the piston-ring. The piston-ring and the trunks are further connected with the piston, so that all the parts rotate together.

Another portion of the invention relates to the regulation of the gaseous charge, by a governor consisting of an axis driven in any suitable manner from the crank-shaft of the engine. Upon the axis, there is a collar, and at a distance from the collar there is a slider; and these are connected with each other by rule jointed links. At the joints of the links are the weights or balls of the governor. The rotation of the axis tends to throw the weights outwards, and to draw the slider along the axis towards the collar; but this action is resisted by a coiled spring around the axis, which controls the movement of the slider. The slider is connected with a rod contained within the axis, and imparts to it a longitudinal movement. The governor axis is geared with another axis which rotates once in the cycle of the engine; and upon this axis there is a sleeve sliding with groove and feather, and having several cams upon it, either of which, by the movement of the sleeve, can be brought into position to operate upon the gas-valve through an interposed lever. The sleeve has also right-and-left threads or worms upon it. In front of the sleeve is a T-form lever, which rocks on an axis at the centre of its head; and on the two sides of the head there are teeth. The rod moved by the governor is jointed to the stem of the lever; and the movement of the stem brings the teeth upon the lever into gear with one or other of the worms. The sleeve then slides along its axis and shifts the cams, as may be required.

The last part of the invention relates to the ignition of the gaseous charge, which is effected by allowing a portion of it to enter a capsule enclosed in a furnace, within which (by a flame playing upon the exterior of the capsule) it is maintained at a high temperature. A short porcelain tube, open at both ends, is arranged to fit on a seat at the ignition-port in the cylinder; and one end fits to, and is closed by, a block (it may be of metal) pressed up to the tube by a spring, the pressure of which serves to hold the tube in place. Ignition capsules thus fitted are, it is claimed, less liable to break by unequal expansion in heating; and in case of fracture, they are easily replaced.

Gas-Controlling Appliances.—Clarke, J., Haynes, W., and Robinson, F., of Leicester. No. 10,487; June 20, 1891.

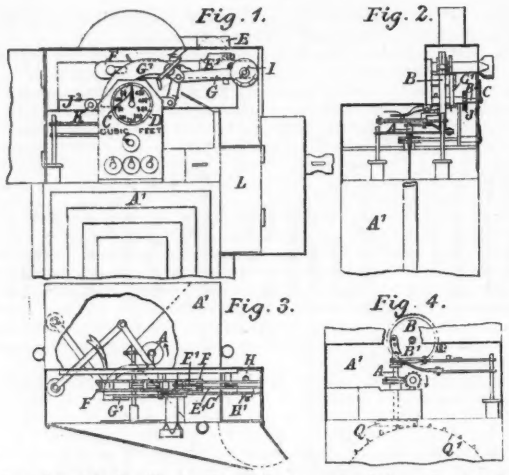
This invention is applicable more particularly to gas stands used by "finishers" of boots or shoes; but it can also be applied for controlling a whole room of gas-jets at one time, by the employment of a frictionless valve contrivance. This is so arranged that, when the tools are taken off the tool-pan, it rises, and the balanced end descends, and carries with it a rod attached to the arm of the tool-pan. To this is connected a valve-rod fitting through the cap of a packed valve-box; and to the lower end of the rod is attached an inverted cup-valve, which descends upon, and closes over, the conduit, and shuts off the gas supply—the cup at the same time entering a layer of quicksilver put in the bottom of the valve-box round the wall of the conduit, through a screw-tapped hole and channel in the rim; thus obviating any chance of spilling the quicksilver. The pilot-burner is arranged up the outside of the Bunsen heating burner; but unlike ordinary gas-stands, the jet is not conducted to the inside, but is left outside—the "blue light" igniting at the upper edge of the tube. When the tools are again placed on the pan, the valve-cup is raised, and the blue light is immediately obtained for heating the tools.

In applying this valve contrivance to control a number of lights at one time, in places where "pilot jets" are employed to ignite large burners, or the lights are required to be put down to a glimmer, it is arranged that the top of the cup-valve rod shall be forced in by pressure or heat, whichever may be most convenient, and at any desired point above the supply; so that the gas is shut off in the manner already described.

Automatic Gas-Meters.—Haynes, J., of Liverpool. No. 13,368; Aug. 7, 1891.

This invention relates to coin-freed or coin-actuated mechanism in connection with gas-meters; its objects being: (1) The providing of facilities whereby a definite quantity of gas may be delivered in return for a coin or coins without the use of valves; (2) the providing of means whereby the vendor of the gas may expeditiously alter *in situ* the quantity of gas to be given per coin, when a change takes place in the price of the gas.

In applying the invention to dry gas-meters, it may be carried into



effect as shown in the illustrations—figs. 1 and 2 being a front and side elevation respectively of the meter; fig. 3, a plan partly in section; and fig. 4, a back view of a portion of the meter

A is a spindle driven by the diaphragms or measuring chambers of the meter, and carrying an arm or projection, moving in a constant direction with the diaphragms. B is a ratchet-wheel, provided with a stop pawl having teeth, which engage with teeth on the arm, on A, and prevent the rotation of the latter and the working of the meter. It is so arranged that this shall take place when the meter is at zero. The ratchet-wheel, which is connected by a friction device and a suitable train (not shown) to the index gearing of the meter—preferably to the first driving-wheel thereof—carries a central spindle B^1, which projects through the front of the meter, and is provided with a pointer C, which moves in front of a dial D, graduated inversely to the usual manner, for the purpose of indicating the quantity of gas which has to be consumed before the pointer arrives at zero, as shown in fig. 1. E is the coin-slot, and E^1 a moveable coin-carrier, having a slot adapted to receive a coin of any predetermined kind. In the normal position of the carrier, the coin is supported by a fixed abutment below it. F is a moveable carrier, provided with a pawl, which engages with the teeth of the ratchet-wheel B. This pawl-carrier is so arranged with respect to the coin-carrier that, when the latter contains a coin of the proper kind, any movement of the latter will be communicated to the pawl-carrier by means of a midfeather F^1 (fig. 3); but when there is no coin in the carrier, the latter will simply slide on each side of the midfeather, and will not affect the pawl-carrier. The coin-carrier is connected by a link G with a weighted lever G^1, which may be raised from the exterior of the meter by a thumb-piece or other equivalent device; the tendency of the weighted lever being always to return the coin-carrier to its normal position. The lever has a definite amount of movement; but the connection between the link and the coin-carrier is adjustable in such a manner that the stroke capable of being imparted to the carrier by the movement of the weighted lever may be varied.

The form of adjustable connection is as follows: The pin H, connecting the link G and coin-carrier E^1, works within a slot in the carrier, and is provided with a cam H^1 adapted to bear upon a fixed pin. It is so arranged that, when the link pin H is rotated in its slot, the distance between the face of the cam H^1 and the fixed pin is varied; consequently, the link G, during a varying portion of its stroke, does not operate the carriers. The link pin is provided with a pointer I, which moves round a dial attached to the link G; so that the amount of stroke may be readily adjusted. When the mechanism is in its normal position, and the ratchet-wheel pointer C is at zero, the arm, moving with the meter mechanism already described, is in contact with the stop-pawl on the ratchet-wheel B; so that all movement of the meter is prevented. The coin-carrier E^1 is now located with its slot below the coin-slot E in the meter-case A^1; and any movement imparted to it by the thumb-piece will not affect the pawl-carrier F and ratchet-wheel B. On the insertion of a coin of the proper kind into the coin-slot, it falls down into the carrier E^1 (being supported by the fixed stop above alluded to), and forms a connection between it and the pawl-carrier F. The weighted lever G^1 being now raised by means of the external thumb-piece, the two carriers are moved along to a given distance, depending upon the adjustment of the link-pin H. This movement imparts an angular movement to the ratchet-wheel B in a direction opposite to that in which it moves when driven by the index-gearing; the amount of this angular movement being equal to the movement in the opposite direction which will be imparted to the ratchet-wheel B through the index-gearing, by the passage through the meter of the quantity of gas to be sold for the coin inserted.

The friction device, which permits the rotation of the ratchet-wheel B in a direction opposite to that in which it moves when driven by the index-gearing, is as follows: The ratchet-wheel B and sleeve B^1 run loosely on a spindle; and the sleeve B^1 carries the pointer C at its outer end. J^1 is a sleeve and disc, carrying a pinion; the disc being held against the ratchet-wheel B by the arm J^2. The amount of friction is regulated by a nut and screw K. When the ratchet-wheel B is actuated by the pawl, it overcomes the friction, and turns the pointer C, but not the pinion. The latter, however, on being rotated in the opposite direction by means of the index-gearing, causes the ratchet-wheel B to be rotated in the same direction by reason of the friction.

It will be understood that the partial rotation of the ratchet-wheel B by the pawl-carrier F, removes the stop pawl from engagement with the arm, which, as already mentioned, is moveable with the meter mechanism. The operation of the coin-carrier by the thumb-piece removes the coin from contact with the fixed stop; and, on the release of the thumb-piece, the coin falls out of the carrier into a receptacle L, and the two carriers are returned to their normal positions by the weighted lever G^1. Two or more coins may be inserted successively; the weighted lever being operated for each coin, and the ratchet-wheel moved in a retrograde manner, and to a definite amount, at each such operation. The stop-pawl carried by the ratchet-wheel being now removed from engagement with the arm connected to the meter mechanism, the meter is now free to operate; and, acting through the index-gearing and through the friction device, rotates the ratchet-wheel until the stop thereon is again placed in such a position as to arrest the movement of the meter mechanism. The ratchet-wheel pointer C now indicates zero; and the flow of gas being stopped, another coin or coins must be inserted, and the ratchet-wheel again moved for each coin, to obtain a further supply.

The mode of action is as follows: Having placed the cam H^1 in such a position, relatively to the stop, that a given amount of gas will be allowed to pass through the meter for a certain coin, the latter is dropped through the slot E into the carrier E^1. The thumb-piece is now turned; and, by means of the link G, the carriers E^1 and F are moved along, taking the coin with them, until the pointer C, actuated by the pawl and ratchet-wheel B, arrives at the number on the dial which indicates the amount of gas the user is to receive for a given coin. The thumb-piece is now released; the coin falls out of the carrier into the receptacle L; and the above parts resume their normal position. The ratchet-wheel B, having been rotated, has raised the stop-pawl from engagement with the arm; and the meter being now free to operate, it acts, through the index-gearing and friction device, and rotates the ratchet-wheel B, and with it the pointer C, until the latter arrives at zero. At the same time, the stop-pawl is again placed in such a position as to arrest the movement of the revolving arm and stop the passage of gas through the meter.

When the invention is to be applied to wet meters, the revolving arm or its equivalent is connected with a star wheel Q in the interior of the meter; and, by means of a spindle working through a stuffing-box, this star-wheel is actuated by one or more projections upon, or moving with, the meter-drum Q^1 (as shown in dotted lines in fig. 4).

Manufacture of Gas (the "Dinsmore Process").—Fergusson, J. H., of Liverpool. No. 13,431; Aug. 8, 1891.

This invention, says the patentee, has mainly for its object the production of illuminating gas of higher candle power and greater volume from a given quantity of coal than is now produced by the ordinary processes employed—that is to say, to produce a gas of high illuminating power and of a large volume from ordinary coal, without the use of cannel.

The coal is distilled in a plurality of ordinary retorts, or equivalent retorts, and carried up to and through liquid in a hydraulic main, wherein the heavier portion of the tarry vapours, or some of them, are deposited. The gas (that is, the combined volume of several retorts, with the remaining uncondensed vapours) is then conveyed from the hydraulic main and passed through a duct or chambers, the temperature of which is comparatively low, especially at the outlet—materially lower than the temperature at which the coal-distilling retorts are maintained. In passing through this duct, the tarry vapours are distilled along with the non-permanent or insufficiently distilled gases, and converted to permanent gas; and this, along with the rest of the gas, then passes out of the duct through a cooling pipe or passage on the outlet portion of the duct, by which the temperature of the gases is reduced, and the prevention of deposition of pitch or other hard carbonaceous substances on its surface, or in the conduits into which it delivers the gases, is claimed to be effected. The temperature of the duct is controlled by dampers, so arranged that the quantity of heating gases admitted to the chamber in which it is placed is controlled, and any portion or portions of the chamber cut off. The heating of the duct may be effected, if desired, by the gases leaving the retort-beds after having heated the retorts therein.

In this process, it will be seen, the coals are distilled in retorts kept at a high temperature; and the resulting gases are then led to a liquid seal (such as a hydraulic main), and the whole body of the gas with the tarry vapours is then subjected to a reheating or second distillation at a comparatively low temperature. In this way, the tarry vapours and non-permanent gases are converted into permanent gas in the presence of the other, or bulk of the gas; and then the whole combined volume is artificially cooled upon leaving the reheating duct.

Liquid tar may also be used under this invention, "with advantage, as by its use the quantity and quality of the gas produced is further increased." The gas is treated in the same way as above described, and led through the hydraulic main; but tar is introduced into the duct and gasified. The duct is in this case preferably built apart, and heated by a separate furnace of its own, so arranged as to enable the heat to be controlled without interfering with the retort-benches.

The gas from the hydraulic main from the ordinary retorts may be passed into the duct along with tar, into or near the end of the duct which is hottest, and where the heat is sufficient to gasify the tar; but it is preferable to allow the tar alone to enter the duct at the point where the duct is hottest, and let the gas from the coals into the duct farther along, where the duct is cooler, when the two gases mix and travel along together through the duct at a graduated temperature, till they reach the water jacket. No more tar must be run into the duct than can be gasified; and hence the more heat in the duct where the tar falls, the more tar will be gasified, and *vice versâ*.

When the invention is applied to, or used in connection with, ordinary gas-making processes and plant, the combined volumes of gas produced in several beds of retorts may be led to, and treated in, one reheating duct; and the retorts of the beds may be charged in rotation, so that the gas being introduced into the duct is practically constant in quality and quantity.

Although this invention, as above stated, is mainly intended to be used to dispense with the use of cannel coal entirely, yet the patentee considers it may be used in cases where cannel coal is being carbonized, in which event (and even where only ordinary coal is employed) the high-power illuminating gas which would be produced, and which would be above the requirements as to quality, may have its quality reduced by diluting it with hydrogen, producer gas, or other diluent,

to bring it down to the required standard. This diluent can be let into the duct with the coal gas, or at other points.

Fig. 1.

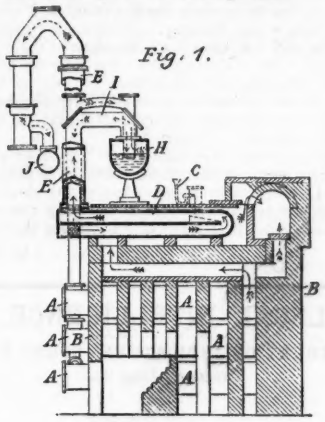


Fig. 2.

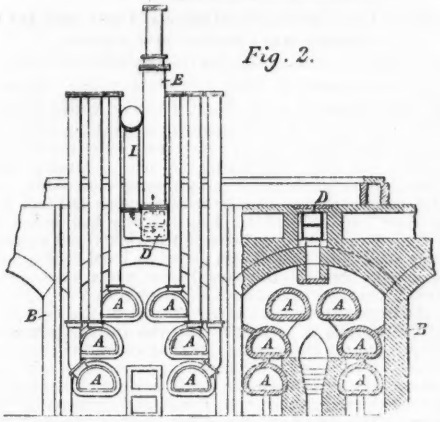


Fig. 1 is a longitudinal section of one arrangement of plant; and fig. 2 is an outside end view and part cross section of it.

As regards the arrangement and mode of heating, the duct is substantially the same as that described in patent No. 15,947 of 1889.* D is the duct; and A, the retorts. B is the brickwork or setting of the retorts; and E is the cooling pipe, by which the gases are cooled artificially upon leaving D. H is the hydraulic main, into which the gas is led in the ordinary way by the ascension-pipes; dip-pipes being employed, as usual. I is a pipe connecting the hydraulic main H with the lower chamber of the duct D; and J is the foul main, into which the gas passes after having been cooled in the pipe E. The cooling artificially of the pipe E may be effected by jacketing and passing a cooling fluid (such as water or its equivalent) through it; or it may be done in any other manner. C represents, in dotted lines, a trapped or syphon-tube device for introducing tar into the duct D; the tar being adapted to fall on to the division-plate of the duct D, as shown.

In operation, the gas made in the ordinary distilling retorts A passes by way of the ascension-pipes into the hydraulic main H in the usual way. From here it flows by the outlet-pipe I into the lower chamber of the duct D; travelling to the back end, and then up at the back end and through the upper chamber. Instantly upon leaving the duct D, it passes into the cooling-pipe E, which is placed upon the mouth of the duct D, and is thereby cooled. After leaving the pipe E, the gas passes to the foul main J, or other outlet.

"The action and effect of this mode of treatment," says the patentee, "are that the gas first passes into the hydraulic main in the usual way, wherein it deposits some of its condensable matters. It is then conveyed, with its tarry vapours, or non-permanent gases, into the heated duct D and passed through same, whereby these tarry vapours, or non-permanent gases, are largely converted to permanent gas. The temperature, however, of the duct D is much lower than that of the retorts—say, from about 1000° to 1300° Fahr.; this temperature being maintained to prevent injury of the gas. And after this the gas is cooled as above specified."

Manufacture of Water Gas, and Purifying and Separating Mixed Gases.—Longsdon, A.; communicated from F. Krupp, of Essen, Germany. No. 8426; May 4, 1892.

This invention relates to a process for commercially obtaining a raw gas (composed chiefly of hydrogen and carbonic acid gas) by passing water vapour over carbonaceous materials; such materials having been previously impregnated with a substance which prevents the process being carried on at such a heat as will produce an undesirable reaction.

The specification of the process (which is not illustrated) is as follows:—

Gas, as previously manufactured, by conducting water vapour over highly-heated coke or other suitable carbonaceous fuel, is, owing to the large proportion of carbonic oxide present, unsuitable for many purposes, and has not generally been adopted for domestic use on account of its poisonous properties. The process hereafter described has for its object to obtain a gas nearly completely free from carbonic oxide, and to produce from water vapour and coal in the simplest possible way two products—one practically pure hydrogen gas, and the other practically pure carbonic acid gas or carbon dioxide.

This process is based upon the fact that the reaction between water vapour and carbonaceous material at low temperature—below 1000°C.—takes place more in the sense of the equation $C + 2H_2O = CO_2 + 4H$—*i.e.*, one part of carbon + 2 parts of water = 1 part of carbonic acid gas + 4 parts of hydrogen gas; and that therefore at a low temperature a gaseous mixture is obtained containing more carbon dioxide and hydrogen gas, and less carbon monoxide than when the reaction takes place at a higher temperature. The conditions necessary for such a reaction to take place exclusively, could not hitherto be fulfilled. There always were obtained considerable quantities of carbon monoxide, which were mixed with the gas, the production of which is explained by the equation $C + H_2O = CO + 2H$—*i.e.*, one part of carbon + 1 part of water = 1 part of carbonic oxide + 2 parts of hydrogen gas; or $C + CO_2 = 2CO$—*i.e.*, one part of carbon + 1 part of carbonic acid gas = 2 parts of carbonic oxide.

In order that the gasification should take place as much as possible according to the first reaction, without the two secondary reactions, it is necessary that the carbonaceous material (wood, charcoal, coke, peat coke, &c.) should be impregnated with a substance which will prevent the temperature of the heated carbonaceous material being raised to a higher point than that requisite for such reaction—namely, that the decomposition should take place at the lowest possible temperature. Any metallic oxides, hydrates, or salts are suitable for this purpose which, in the operation in question, do not cause any secondary reaction, and which will prevent any simultaneous production of sulphuretted hydrogen, chlorine, hydrochloric acid gas, &c. The hydrates of the alkalies and of the alkaline earths, and also the carbonates of the alkalies, are especially suitable for this purpose.

When the above-named carbonaceous material is impregnated, for instance, with a solution of carbonate of potassium, and the dried mass is brought to a red heat in a retort or in other suitable apparatus, and superheated steam or ordinary water vapour is conducted over same, the production of carbonic oxide is nearly completely prevented; and the gas produced contains carbonic acid and hydrogen gas, with only very small quantities of other gases. The analysis of such a raw gas obtained from peat coke gave the following result:—

Carbonic acid	26·4 per cent.
Carbonic oxide	1·2 ,,
Hydrogen	62·0 ,,
Hydrocarbon gas—CH	2·3 ,,
Nitrogen	6·5 ,,
Oxygen	1·5 ,,

This raw gas when produced would possess a high calorific value; and after the expulsion of the carbonic acid, would consist chiefly of pure hydrogen. The above proportions would have been, of course, still more favourable if the accidental impurities and atmospheric air indicated by the analysis could have been avoided.

The raw gas produced in the above-described manner is, however, as such, already fit for industrial use owing to its calorific value. The further process consists in separating from each other the two gases of which the raw gas chiefly consists—viz., carbonic acid and hydrogen—and in obtaining each of these gases separately by absorbing the carbonic acid, and then extracting the carbonic acid again from the absorbent mass.

For separating from the raw gas the carbon dioxide mixed therewith, all the hitherto known absorbing agents—such as lime, alkalies, &c.—may be employed; but in order to carry out the separation economically, and to render the carbonic acid valuable for other purposes, the process hereafter described is employed, which process is based on the production and subsequent decomposition of bicarbonates of the alkalies. A purifying mass is made by mixing coarsely powdered wood charcoal, and an organic substance easily decomposable by heat—such as meal, molasses, sawdust, &c.—with a concentrated solution of carbonate of potassium or of sodium, evaporating to dryness, and heating in closed vessels until the mass glows. Thus a porous pumice-like mass is obtained, which forms, when moistened, an extraordinarily efficacious absorbent for carbon dioxide. For a similar purpose, coal or coke impregnated with the solution may be employed.

The mass when prepared is placed in a suitable apparatus and moistened with water. The mixed gases are then conducted over the mass, which will entirely absorb the carbonic acid; the hydrogen gas passing over unchanged to be collected in a store receiver for immediate use. When the purifying mass is saturated, in order to obtain the absorbed carbonic acid and at the same time regenerate the mass, it is only necessary to cause a current of water vapour to pass through the apparatus, or in other ways to decompose the produced bicarbonate—for instance, by heating; and thus the mass may be renewed and the process repeated at pleasure.

If the gas to be purified contains other gases capable of being absorbed by the carbonate, the purifying process must be modified according to the character of the gas to be removed.

Another process particularly suitable for separating carbon dioxide from hydrogen gas, water gas, heating gas, and other gases containing carbonic acid gas or carbon dioxide (and which also may be utilized for obtaining pure carbonic acid gas), is based upon the fact that it is possible to absorb carbon dioxide by alkaline earths when they are brought to a red heat, and to expel it again by means of water vapour. For this purpose, lime as magnesite and dolomite in a burnt or unburnt condition may be employed; but burnt lime or oxide of calcium, such as is obtained by burning limestone, marble, &c., is particularly advantageously employed. The advantage of this process, compared with other similar processes, is that it can be carried out continuously, and that the gases and the absorbents act on one another in a dry condition, so that the application of aqueous solutions is avoided.

To carry out the process, a retort or other similar suitable receiver is charged with lime, limestone, or with such bodies which in burning leave a residue of oxide of calcium. The material is then brought to a bright red heat, and water vapour (if required in a superheated condition) is conducted over it until the carbon dioxide is expelled. When the burnt lime is still at a red heat, hydrogen or another gas containing carbon dioxide, is conducted over it; and a quick absorption of carbonic acid and a purification of the mixed gas will take place. When the

* See JOURNAL, Vol. LVI., p. 946.

ime is saturated, the admission of mixed gas is cut off, and the carbonic acid absorbed is expelled by causing water vapour to pass over the absorbent substance. The expulsion and absorption of the carbonic acid can be continued in an alternating manner, until after some time the action of the lime, owing to the alteration of its pure condition by dust, &c., has become too weak, and a supplementary or renewed charge is required. The temperatures necessary for the absorption of the carbonic acid, and for its expulsion by water vapour, are very nearly the same; and, in consequence, the whole process may be carried out without considerable variations of temperature and with a very small loss of heat. The escaping carbonic acid can be easily re-collected, and utilized for other purposes.

CORRESPONDENCE.

The Question of Gasholder Guiding.

SIR,—Notwithstanding the highly mathematical paper of Mr. Walmisley, and the more elementary production of Mr. Gadd, on the subject of gasholders, which The Gas Institute has given to us, we are "no forrarder" in the direction of obtaining absolute proof that the side sheeting of a gasholder can be depended upon to safely resist the imperfectly understood diagonal stresses that must come upon it in the absence of external guide-framing. I think Mr. Walmisley must take the view that those stresses would be very severe, because in his able paper he throughout assumes that external guide-framing is necessary; and much of the paper is devoted to the consideration of the possibility of the opening of the cup joint on one side, under the action of wind pressure, if a gasholder is not properly supported by guide-framing. This point was fully considered before deciding to add a third lift to the Rotherhithe holder without extending the guide-framing; and experiments were made on a small two-lift holder, of which each lift was about 8 feet high by some 6 feet in diameter—the top lift being unguided. The height was greatly out of proportion to the diameter, to the disadvantage of the stability of the holder; but even so it was only possible, by violently pulling at a rope attached to the top, to effect a momentary opening of the cup joint on one side, with the result that some of the water was blown out, and the holder came down harmlessly by the run. The conclusion was that although, with the top lift free from the guide-framing, there is a tendency, under great wind pressure, for the lift to be depressed on one side, and the cup joint to open, the forces tending to keep it closed are so *very much greater* that there is no possibility of such opening taking place.

Referring to Mr. Gadd's paper in last Tuesday's JOURNAL, there is not even an attempt to deal with the diagonal stresses on the side sheeting in gasholders guided on his system. I do not now go into the question whether, under the great stresses on large gasholders resulting from wind pressure, the rollers and their attachments on his system can be made of sufficient strength, and can be so accurately adjusted that none shall be liable to fracture or distortion consequent on their having to do more than their share of the work; but I would draw attention to the remarkable omission on the part of Mr. Gadd to touch upon the effect of the diagonal stresses on the side sheeting, when it has to do the work hitherto done by the guide-framing—viz., to transmit to the ground the force exerted by the wind on the gasholder. If that force is nearly as great in exceptional storms as is generally supposed, necessitating the use of strongly-braced guide-framing, it follows that, if the guide-framing is dispensed with, the work hitherto done by it must be done by the side sheeting of the holder.

I do not think it has been made clear what effect the internal pressure of the gas has upon the side sheeting, in enabling it to bear diagonal stresses. This, without doubt, would help the sheets; but it is very doubtful whether it would do so to a sufficient extent to prevent injury to the holder.

Allow me to say, in conclusion, that it is far from my wish to prove that external guide-framing cannot be dispensed with in the case of large gasholders. On the contrary, it would be a great advantage thus to simplify and economize their construction. Let us have all doubts removed, if possible; and then engineers will be free, without anxiety or fear of a catastrophe, to adopt the plans of either Mr. Gadd, who was the first to solve the problem, or Mr. Pease, to both of whom great credit is due for the originality and cleverness of their respective inventions.

July 14, 1892. GEORGE LIVESEY.

The Electrical Supply Business in London.

SIR,—Is there not an error in the calculation of the percentage of output of electric light in London, reduced to its equivalent in cubic feet of gas, in the paragraph on p. 64 of your yesterday's issue? The electric light output is taken for the *year*, and that of The Gaslight and Coke Company for the *half year* ending Dec. 31, 1891. So that, assuming the output on the first half to have been equal, the percentage would be 3·32, not 6·64; and the former figure agrees much more nearly with our own information as to the percentage equivalent in our district.

Lowther Gardens, S.W., July 13, 1892. W. T. MAKINS.

Coal Analyses.

SIR,—The issue of coal analyses seems to claim some notice at the present moment. These fly-sheets were perhaps never very reliable, but they served to give some idea of the relative values of fuel offered. Many recent ones, however, must have excited the surprise not only of gas engineers but colliery proprietors. I have before me three analyses, from different sources, of the same coal, which give the following results:—

	Cubic Feet per Ton.	Illuminating Power. Candles.	Equivalent of Ton of Coal in Pounds of Sperm.
A	10,088	17·33	591·70
B	10,691	18·36	627·00
C	12,780	22·35	979·31

These figures, I think, do not need any comment.

Belfast, July 11, 1892. J. STELFOX.

Herring's "Gas-Works Construction."

SIR,—Mr. Newbigging has called my attention to the fact that, when treating of the hydraulic main in the above work, I have made use of his writings in the "Gas Manager's Handbook" without giving him the full credit thereof. At the commencement of the extract on p. 127, I have stated that "the following discourse bearing on the subject is extracted from 'Newbigging's Handbook;'" but, as Mr. Newbigging rightly points out, the quotation signs end on p. 129, instead of p. 132. In my MS. the quotation signs are correctly placed; but the printers have neglected to take note of them.

Mr. Newbigging further says that there are other passages closely resembling his writings. Although unconscious of directly abstracting from his work, I nevertheless desire to tender my sincere apologies to him for anything I may have used without giving the proper acknowledgment and due credit therefore; and I will see that the omission is rectified.

Huddersfield, July 11, 1892. W. R. HERRING.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Tuesday, June 28.

(*Before the* MASTER OF THE ROLLS *and Lords Justices* BOWEN *and* A. L. SMITH.)

Kirkheaton (Yorks.) District Local Board v. Ainley, Sons, and Co.

A Question as to the Pollution of a Stream.

This case, which for some years has been before the Courts of Law and Equity, was decided by their Lordships to-day. According to the report which appeared in *The Times*, it was an appeal by the Local Board against a decision of a Divisional Court, setting aside an order of the County Court Judge for an injunction, under the Rivers Pollution Prevention Act, 1876, restraining the firm of Messrs. Ainley and Co. from sending the products of certain water-closets they had constructed for their workmen into the sewers, which fall into a "beck, stream, or river," and pollute it. The difficulty had arisen from an apparent conflict or confusion between the rights and powers as to sewers under the Public Health Act vested in local boards, and as to rivers and streams vested in the same bodies under the Act of 1876; these boards being the local authorities under both Acts. The defence set up by the firm in this case, and the ground of the decision of the Divisional Court, was, in substance, that the Board themselves were responsible for the sewers running into the stream, and should prevent this, if it were desirable, or so construct the sewers as to do away with the evil (the sewers being vested in the Board); and that the firm had a right to send the sewage into the sewers, and were not liable for the consequences. The Board, on the other hand, contended that their duties under the Act of 1876 were quite distinct from their functions as to sewers under the Public Health Act and under a later Act; and that their having duties as to the sewers, even if they had neglected those duties, did not at all interfere with the exercise of their functions under the Rivers Pollution Prevention Act, and that it was enough for them to say that they had not in any way authorized the sending of the sewage into the stream, and it was the duty of the firm of Messrs. Ainley and Co. to construct cesspools; that they had no authority to send the sewage through the sewers into the stream, which was wrongful under the Rivers Pollution Prevention Act; and that the Local Board were not precluded from proceeding to prevent it. Much litigation had arisen on the subject, apart from the present proceedings. Messrs. Ainley and Co. brought an action in Chancery, before Mr. Justice Stirling, to prevent the Board from cutting off the connections between the water-closets and the sewers; and the Judge had decided that the Board could not cut them off. Further, there was an application to the Local Government Board to compel the Local Board to construct an efficient system of drainage; but that Board, in the exercise of their discretion, and considering the great expense such a scheme involved, declined to sanction it, but sent down an Inspector to report as to what was required. Then there was an application to the Queen's Bench Division for a *mandamus* to the Local Board to construct an efficient system of drainage, and this was now pending. In the meantime, the County Court Judge made an order by way of injunction against the firm of Messrs. Ainley and Co., to prevent them from sending their water-closet drainage into the sewers; and the Divisional Court set it aside.

Mr. DODD, Q.C., appeared for the Board; Mr. BOSANQUET, Q.C. (with whom was Mr. C. M. ATKINSON), argued in support of the decision of the Divisional Court

The MASTER of the ROLLS said the first question was whether the defendants were offenders against the Rivers Pollution Prevention Act by sending the sewage into the stream. No doubt they sent it into the sewers, which ran into the stream. Did they thus "cause" it to go into the stream? Clearly they were the *causa causans*. Did they "cause" the pollution? He thought they did; and that therefore they were liable under that Act. Then were the Board precluded from taking the proceeding? Did their dereliction of duty, if any, in not preventing the sewage from going into the stream prevent them from proceeding? Did it show that the defendants were not liable, or that they and the Board were both liable? Did that, however, justify the defendants? He thought that it did not, and that, unless there was anything to prevent it, they were liable to the injunction. Now, it seemed clear, from the Act, that the granting of the injunction was discretionary; and if the Court thought the County Court Judge ought not to have granted it—and that was a ground of appeal—the exercise of their discretion by the Divisional Court in overruling the Judge was right. When it was considered that the mere act of sending the sewage into the sewers by itself was not wrongful, and that when put there the Board could have dealt with it and had given no reason for not dealing with it, and had not shown that they could not have dealt with it with reasonable expense, he thought the Divisional Court were right in holding that the injunction ought not to have been granted.

Lords Justices BOWEN and SMITH delivered judgment to the same effect.

MANCHESTER ASSIZES.—NISI PRIUS COURT.

Wednesday, July 13.

(*Before Mr. Justice* DENMAN *and a Special Jury.*)

The Blackburn Gas Explosion—Action for the Loss of a Husband.

This was an action, brought under Lord Campbell's Act, by Jessie Paterson, widow of James Paterson (who was killed by the explosion of gas at the Crown Hotel, Blackburn, on Nov. 30 last*) to recover damages for the death of her husband, which, she alleged, had been brought about by the negligence of the servants of the Blackburn Corporation.

Mr. GULLY, Q.C., M.P., and Mr. PARRY appeared for the plaintiff; Mr. BIGHAM, Q.C., Mr. LAWRENCE, and Mr. MATTINSON for the defendants.

Mr. GULLY, in opening the case, said that plaintiff's husband was killed in an explosion of gas which took place at the Crown Hotel, Blackburn, on Nov. 30 last; and the action was brought against the Blackburn Corporation, the proprietors of the gas-works, to recover damages on behalf of the plaintiff and such of her children as were under age. Paterson was a travelling draper and commission agent; and he might state that, if the verdict should be in the plaintiff's favour, he and his learned friend on the other side had agreed as to the amount of the damages to be awarded and apportioned between the plaintiff and her children. The issue to be tried therefore was whether or not the accident was caused by the negligence of the Corporation servants. In one of the cellars of the Crown Hotel, Blackburn, there was a large meter, not used for the purposes of the inn at all, but to supply the stalls in the adjoining market. It was under the control of a man named Ormerod, who used to collect the rents from the stallholders, and pay the money over to the Corporation. He used to turn the gas off at a certain time each night, except on Saturday, when it was kept on very late, and the landlord of the hotel undertook the duty. In September last, the Corporation decided to change the system by which the stallholders in the market obtained their gas; and they announced that, after the 30th of that month, each stallholder would have to have a meter of his own. Under these circumstances, the meter in the cellar of the Crown Hotel would be of no further use; and, shortly before Sept. 30, Ormerod was informed that the gas would be cut off from the large meter. When Ormerod heard this, he tried to sell the meter to the Corporation servant who spoke to him on the matter, but refused to accept 10s. for it. The meter was actually disconnected on Oct. 5 by men in the service of the Corporation. Notice was given to Ormerod; and he then told one of the Corporation's men that he would take the meter away. The men who disconnected the meter simply took out the tap in the pipe, filled up the hole in the tap with a mixture of white lead and tallow, and replaced it. While that was an effectual manner of stopping the supply of gas temporarily, it was, he submitted, a most careless and imperfect way of doing the business when the meter was to be permanently put out of use, and when it could be taken away by the owner. What they ought to have done was to take up the pipe leading to the main and insert what was called a "blank end" in the main itself, or else put a "blank end" in the service-pipe at the point where it entered the cellar. Ormerod eventually sold the meter to a man named Robinson; and on Nov. 30, Robinson and his brother went to the cellar to remove it. They disconnected it at the point where the pipe from the meter fitted into the pipe coming from the main, and were preparing to disconnect it from the outlet-pipe when the pipe leading to the main fell away from the end of the service-pipe, and there was a tremendous rush of gas into the cellar. Robinson and his brother, after blowing out the candle they were using, ran upstairs to tell the landlord of the hotel and warn people to get out of the way. They also sent word to the gas office; but before anyone arrived, a terrible explosion took place, the house was wrecked, and seven people were killed. It was afterwards discovered that the pipe from the meter to the service-pipe had only been screwed on to two or three threads of the screw at the end of the service-pipe; and, consequently, when the meter was removed from the other end, the weight of the suspended pipe caused it to fall, and so allowed the gas to have free access to the cellar. This, the learned Counsel contended, was due to the negligence of the servants of the Corporation; and he urged that, as they had not done what they ought to have done, they should be held liable for the accident that happened and for the results.

Witnesses were then called in support of the plaintiff's case.

George Ormerod narrated the circumstances which led to the cutting off of the supply of gas to the large meter.

In cross-examination, witness denied that he had told Robinson, to whom he had sold the meter, that there were two brass taps connected with it to which he was entitled; but he did say there was "the tap," and Robinson had complained that the tap was not brass.

Mark Robinson described the mode in which he endeavoured to remove the meter. He severed the unions with the meter, and previously turned the tap on to see if any gas came and found none, showing, as the landlord had told him, that it had been cut off. He afterwards heard a rush of air or gas. He then smelt gas; but at first thought it was from the pipe connected with the market stalls.

Cross-examined: He did not interfere with the pipe that had caused the explosion. While they were severing the connection with the meter, they heard something fall. They did not know what it was at the time; but it proved to be the service-pipe. Neither he nor his brother interfered with that pipe and he did not know when they rushed from the cellar where the gas came from. They had not intended to remove the meter from the cellar on the day in question, but only to get it ready to be taken away by the brewer's cart when it called with beer for the hotel.

James Haughton the landlord of the Crown Hotel said he saw the men at work in the cellar; but they were not there long. After Robinson went to give notice of the escape of gas at the gas office, he noticed an odour of gas, and opened all the doors to let it out. He was injured by the explosion, and was bringing an action against the Blackburn Corporation for damages.

* See JOURNAL, Vol. LVIII., pp. 1052, 1091; Vol. LIX., p. 536.

Mr. T. Newbigging said the universal practice in cutting off a supply of gas permanently to any place was to do it at the main, with a blank end screwed on. He could not imagine why it had not been done in this case. It was not a prudent thing to leave a service-pipe projecting into a cellar. The mere plugging of the pipe in this case was improper and altogether unsatisfactory.

Mr. BIGHAM objected that there had never been any complaint as to the condition of the service-pipe; and said that the case now attempted to be set up by the plaintiff was that the pipe had fallen away owing to its not being properly screwed into the socket, of which no notice had been given in the pleadings. His theory was that the escape of gas was owing to Robinson and his friend improperly attempting to take away the tap, which could only be done by removing the whole pipe from the socket.

His LORDSHIP ruled that the particulars in the pleadings of the plaintiff were large enough to include this allegation.

Witness, in further examination, said the leverage of the portion of pipe left projecting into the cellar was enormous. It appeared to have been held by about a couple of threads. It was probable that Robinson, or his assistant, in severing the connection with the meter, might have caught the pipe with his shoulder or head unconsciously, and that would destroy all calculation as to the strength of the threads to sustain the pipe.

R. Entwistle, a plumber, deposed to the unsatisfactory condition in which the defendants had cut off the gas from the meter.

In cross-examination, he said an experienced gas-fitter would have stopped the escape at once, and there would have been no danger.

Mr. *Isaac Carr* corroborated the evidence of Mr. Newbigging; and *F. Robinson* denied that he said, when he escaped from the cellar, that "they had made a job of it."

Mr. BIGHAM said the case was an important one for the defendants, as, in the event of an adverse verdict, many claims would be made against them. He held that the balance of testimony was in favour of the defendants; and he asked the jury to say that there was nothing before them on which they could fix the liability for the explosion on the Corporation. Could the death of Mr. Paterson fairly and reasonably be attributed to any act of negligence, whether of omission or commission, on the part of the Corporation? It was a complex question; and if they were to decide in favour of the plaintiff, they would have to say, first that there was negligence on the part of the defendants, and then that the death of Paterson was the result of that negligence. The Corporation had no idea that two inexperienced men were going to interfere with the meter, and had no knowledge of it. He held that Robinson and his assistants had tried to get possession of the two taps; and that they had been the means of breaking off the pipe in so doing. The two Robinsons, and not the Corporation, were the persons who had caused the explosion; and though they might regret the death of Mr. Paterson, defendants were not responsible.

Evidence was then called on behalf of the defendants.

Mr. *M'Minn* having given an account of the circumstances which led up to the severing of the connection with the meter in the cellar of the hotel,

Luke Kearsley said, when large meters were disconnected from the mains at Blackburn, it was the custom to use a paste of red lead, white lead, and tallow with which the hole in the tap was plugged. This was done to the tap at the meter at the Crown Hotel by two competent men, named Poulton and Smith, in the employ of the Corporation. He was present, and saw that the work was well done. When gas was permanently cut off from a building, they disconnected the pipe in the street. There were four meters in the Crown Hotel cellar.

Thursday, July 14.

On the resumption of the proceedings this morning,

J. Bates and *B. Bates*, plumbers, deposed to working at the meter some years ago, and getting on the top of it by the aid of the service-pipe, which was firm at that time.

Mr. *John West* said the disconnection of the gas by the Corporation was all that was necessary. There was ample support for the service-pipe in the two or three threads which held it in the socket. Two threads would, when new, sustain a weight of over 3 cwt. The weight of the pipe in the Crown cellar was 35 lbs.

Cross-examined by Mr. GULLY, witness said it was customary, when gas was permanently disconnected from a building, to cut it off at the main. Though the gas might have been cut off from the meter, only some authorized person should have removed the latter. He should never leave a pipe screwed in with three threads only; but use not less than four.

Mr. *J. Hepworth* agreed that the plugging of the pipe was well done. The connection by two or three threads only was a good one, and considerable violence must have been used to get the pipe out.

Mr. *H. E. Jones* and Mr. *F. Livesey* gave corroborative evidence.

Mr. BIGHAM, in addressing the jury, held that there was no evidence of any breach of duty on the part of the defendants. The evidence of the plaintiff was, of course, that the Corporation had been guilty of negligence in disconnecting the service-pipe, the answer to which was that they did not disconnect the service-pipe at all. Then the plaintiff said that the defendants were guilty of negligence because they did not disconnect it; and that the explosion was caused by their not having severed the connection in the street, or put a blank cap on the pipe at its entrance to the cellar, because the Corporation knew that the pipe was not to be used again. He denied that proper notice was given to that effect, but contended that the notice given to M'Minn only meant that the supply to the stallholders was going to be cut off, in order to compel them to keep up the payment of their accounts, and that the supply might be reconnected. The Corporation had no notice that the meter was going to be removed, and had no reason to suppose that anybody was going to meddle with it. What the Corporation had done had made it safer than it was before. The real cause of the explosion was the action of the Robinsons in the cellar; but, of course, a greengrocer and a butcher had not the money to pay damages for the results of the explosion, and so those affected had looked about for somebody with a purse deep enough to pay for it, and the Corporation had been made the defendants in the case.

Mr. GULLY said his case was that the gas was cut off by the Corporation permanently, with a full and sufficient notice to them that it was to be so cut off; and that the usual methods of permanently disconnecting had not been followed in this case. Therefore, the Corporation could not escape from liability because somebody else had not exercised sufficient care in dealing with a dangerous state of things which they had brought about.

His LORDSHIP summed up the evidence at great length; and the jury, after retiring, found for the plaintiff. It had been previously agreed that, in the event of such a finding, the damages should be £600.

Execution was stayed pending the possibility of an appeal.

Friday, July 15.

Mr. BIGHAM this morning asked his Lordship's sanction to a proposal that, pending appeal, the Corporation should pay the widow £50 now and £1 a week until the appeal is heard.

Mr. PARRY assented to the suggestion, and further stated that, subject to his Lordship's approval and the result of the appeal, £400 should be paid to the widow, and £50 to each of her four children, aged respectively 20, 14, 7, and 3.

His LORDSHIP said he thought it would be best to invest the children's portion until each child reached his majority, with power to apply the money at any time for one or another of the children's benefit, if any special reason should arise.

SHERIFF COURT, GLASGOW.—Thursday, July 14.

(*Before Sheriff* BERRY.)

Crawford v. Corporation of Glasgow.—The Supply of Gas for Motive Power.

In this action, Mr. John Crawford, printer, of Mitchell Street, Glasgow, sought to recover from the Corporation of that city, as the Gas Commissioners, £7 12s. 8d. as damages, in respect that on Nov. 27, 1890, the supply of gas which had been afforded to him by the Corporation for the purpose of illuminating his premises and driving his gas-engine suddenly ceased without warning, and that in consequence he had to almost entirely suspend work. The Corporation denied their liability, and stated that any deficiency of pressure on the day mentioned arose from a sudden heavy fog occasioning an inordinate and unusual demand for light. Sheriff-Substitute Erskine Murray, before whom the case was first heard, sustained the defenders' preliminary pleas, and dismissed the action—finding the Corporation entitled to expenses.* Against this decision the pursuer appealed to the Sheriff-Principal (Berry), who has just issued an interlocutor affirming the judgment of the Sheriff-Substitute, with additional expenses.

In a note to his interlocutor, the Sheriff says: It is contended for the pursuer that the defenders were bound to continue to afford a supply of gas sufficient to give motive power to his machinery, or, at all events, that he was entitled to reasonable notice if it was to be stopped. This contention is sought to be rested both on statute and on general principles of law; but on neither ground do I think it can be sustained. As regards common law, *rei interventus* was said to have taken place through the expenditure of money on making the connections, and the alteration of the pursuer's premises for the purpose of the supply, with the defenders' knowledge and consent. In the absence, however, of preceding agreement to give a supply of gas, of which there is no suggestion, the principle of *rei interventus* cannot be relied on. Then on none of the numerous statutory provisions which were brought under my notice does it seem to me that the pursuer can successfully rely.

Coal Storeage at the Coventry Gas-Works.—The Coventry City Council have, on the recommendation of the Gas Committee, resolved to convert eight small houses adjoining the gas-works into a coal-shed, which will increase the storeage capacity by 1000 tons, or ten days consumption.

Conviction for Stealing Gas.—At the Blackburn Police Court on the 8th inst., James Wright, a hair-dresser carrying on business in the town, was fined £5 and costs, or two months' imprisonment, for fraudulently consuming the gas of the Corporation. The theft was effected in the usual way, by connecting a pipe to the service-pipe, and diverting the gas, so that it did not pass through the meter.

The Reliability of Water-Meters.—Under this heading, a paragraph appeared in the JOURNAL for April 26 last, recording the result of an action by the Dorking Water Company against Dr. King for the payment of £17 8s. 6d. due for water supplied by meter. The jury found that the meter was defective, and registered water as passing through when the supply to the house was shut off; and his Honour Judge Martineau gave a decision in favour of the defendant. The Company subsequently applied for a new trial, which was granted; and a few days later Dr. King paid the whole sum demanded by them. In consequence of this, last Wednesday week, his Honour allowed the Company the costs of the application for a new trial.

Huelva Gas Company, Limited.—In the report of the Directors of this Company for the year ended March 31 last, which was presented at the ordinary general meeting held in Glasgow on the 30th ult., they stated that there was a credit balance of £2320 on the profit and loss account—a decrease of £214. A dividend of 6 per cent., free of income-tax, was recommended, which would absorb £1500. It was also proposed that £350 should be added to the reserve fund, bringing it up to £3900; and that the balance of £470 should be carried forward. The Directors expressed their pleasure in being able to give, on the whole, a favourable report on the operations of the Company. There was an increase in the consumption of gas and the sale of residuals; also in the number of meters employed. On the other hand, expenses were higher; and the loss on remitting money was greater, owing to a fall in the rate of exchange. The outlay on capital account for the year amounted to £1812, mainly for regenerative plant and for extensions of the retort-benches, mains, &c. The regenerative plant was reported to be proving a success, the effect of which would soon make itself apparent in the accounts.

* See JOURNAL, Vol. LVIII., p. 126.

MISCELLANEOUS NEWS.

METROPOLIS GAS SUPPLY.

The Quality of the Gas in the Past Quarter.

The following is an abstract of the report of the Chief Gas Examiner for the Metropolis (Dr. A. W. Williamson, F.R.S.) as to the quality of the gas supplied by The Gaslight and Coke, the Commercial, and the South Metropolitan Companies, during the quarter ending the 30th ult.:—

I. *With respect to Illuminating Power.*—The average illuminating power, in standard sperm candles, at each of the testing-stations, was as follows:—

The Gaslight and Coke Company—	
Fenchurch Street, E.C.	16·8
King Street, E.C.	17·0
Dorset Buildings, E.C.	16·7
Ladbroke Grove, W.	16·4
Devon's Road, E.	16·3
Carlyle Square, Chelsea, S.W.	16·2
Camden Street, N.W.	16·4
George Street, N.W.	16·2
Graham Road, E.	16·6
Kingsland Road, E.	16·7
Spring Gardens, S.W.	16·3
Grove Gardens, St. John's Wood, N.W.	16·2
Hornsey Road, N.	16·6
Lambeth Road, S.E.	16·7
Millbank Street, S.W. (cannel gas)	21·2
Commercial Gas Company—	
Parnell Road, E.	16·3
Wellclose Square, E.	16·4
South Metropolitan Gas Company—	
Hill Street, S.E.	16·7
Bedford Road, S.W.	16·2
Stoney Lane, S.E.	16·5
Lewisham Road, S.E.	16·6
Blackfriars Road, S.E.	16·3
Burrage Road, S.E.	16·1

It will be seen from these results that the average illuminating power of the gas at all the testing-stations of the Companies has been higher than the parliamentary standard of 16 candles. Slight deficiencies in the lighting power were reported during the quarter by the official gas examiners at the Spring Gardens, Grove Gardens, and Lambeth Road stations of The Gaslight and Coke Company, the Wellclose station of the Commercial Gas Company, and the Burrage Road station of the South Metropolitan Gas Company.

II. *As regards Purity.*—Sulphuretted hydrogen was not present in the gas. The average amount of sulphur in other forms than this at all the testing-places was considerably less than the quantity permitted, especially at the Devon's Road station of The Gaslight and Coke Company, and the two stations of the Commercial Company. Certain excesses of the prescribed limit were reported by the official gas examiners in the gas tested at the Fenchurch Street station of The Gaslight and Coke Company, and at all the stations of the South Metropolitan Company. At all the other stations of The Gaslight and Coke Company, and at the two stations of the Commercial Gas Company, the maximum amount present in the gas did not exceed the limit—viz., 17 grains. Ammonia was generally present in the gas more or less frequently throughout the quarter at all the stations, but only in slight quantities. The limit allowed was not exceeded on any occasion.

GAS PROVISIONAL ORDERS (SESSION 1892).

In addition to the Provisional Orders comprised in the Confirmation Bill noticed in the JOURNAL for May 17 last, four others were grouped in a second Bill, particulars of which have, as usual, been published by the Board of Trade in a Memorandum. They relate to Bideford, Glastonbury and Street, Prestatyn, and Willenhall. The Bideford Order is to empower the Bideford Gas and Coke Company, Limited, to maintain and continue gas-works; to manufacture and supply gas in the township, parish, and borough of Bideford, in the county of Devon; and to supply gas in bulk by agreement outside the limits of supply. It fixes the capital at £12,000 by shares, and £3000 by loan; and the initial price to be charged for gas is 3s. 10d. per 1000 cubic feet, with the sliding scale. The Glastonbury and Street Order is to empower the Glastonbury Gas and Coke Company, Limited, to maintain and continue gas-works; to manufacture and supply gas in the united parishes of St. John the Baptist and St. Benedict, Glastonbury, and the parish of Street, all in the county of Somerset; and to supply gas in bulk by agreement beyond the limits of supply. The capital is fixed at £10,000 by shares, and £2500 by loan; and the initial price to be charged for gas is 4s. 6d. per 1000 cubic feet, with sliding scale. The Prestatyn Order is to empower Mr. H. D. Pochin to construct and maintain gas-works, and manufacture and supply gas in the parishes of Meliden Cwm, Dyserth, and Newmarket, all in the county of Flint; and to supply gas in bulk by agreement beyond the limits of supply. The capital for the purposes of the undertaking is fixed at £5000, and the amount which may be borrowed, at £1250; and the maximum price of gas is 6s. per 1000 cubic feet, with power to the Board of Trade, after three years, to alter it, or to fix a standard price, with sliding scale as to profits. The Willenhall Order is to empower the Willenhall Gas Company to raise additional share capital not exceeding £13,250, and to borrow an amount not exceeding £8000; to construct and maintain additional works; and to supply gas in bulk by agreement outside the limits of supply. The initial price to be charged for gas is put at 3s. 6d. per 1000 cubic feet, with sliding scale.

THE SALFORD GAS FRAUDS.

The Recovery of the Costs of Legal Proceedings.

At the Monthly Meeting of the Salford Town Council last Wednesday—the MAYOR (Mr. Alderman Keevney) in the chair,

Mr. RYCROFT moved a resolution to the effect that the action of the General Purposes Committee in deciding to take no steps to recover the costs due to the Corporation by Hunter, the late Gas Manager of the Corporation, be confirmed. He said that the members of the Council would remember that, when a settlement was made with Hunter, it was part of the arrangement that the costs incurred by the Corporation should be paid by him. If he thought there was a chance of getting any money from the contractors, he would not move the resolution; but it was simply a question of whether, after five years of turmoil and law suits, the Council should embark on further legal proceedings for the sake of, if possible, recovering a little more than £200. He understood that a bill of costs had been delivered to Hunter or his solicitors, and they objected to pay; and if the Corporation insisted on obtaining payment, certain legal proceedings would be necessary and additional expenses would be incurred.

Mr. HOLLAND having seconded the motion,

Mr. MANDLEY said the only question for consideration was whether or not this was a bogus claim. If it was a bogus claim, it was dishonourable to the men who were presenting it; if not, it ought to be proceeded with. He wanted to know whether these costs were incurred in connection with the artfully devised scheme which robbed the Corporation of their right and proper claims on the guilty contractors. Mr. Rycroft spoke of the five years of turmoil, and of the necessity for burying the matter. He held it was not time to have this thing buried; and so long as he lived, there never would be a time when it should be. To relegate the matter to obscurity was to encourage men who were still living, including one who was to this day sitting on the bench. It was not a magistrate of the borough of whom he was speaking; but one of the contractors. Instead of wiping off the £200 odd as they were asked to do, let them go against this one man and make an example of him. If they did, he was sure they would get back a far greater sum than they had any idea of. If there had been a plea of poverty, it might have been a reason for not proceeding against Hunter himself; but there could be little doubt that Hunter was a man of considerable wealth at the present time. He was told that Hunter was one of the most conspicuous people on the race-course during Whit-week. There never would be a settlement of this question until the Corporation had justified themselves in the eyes of the people by proceeding against the contractors.

The TOWN CLERK (Mr. S. Brown), in reply to questions by Mr. Phillips and Mr. Groves, stated that the question had been fully considered by the Consultative Committee and the General Purposes Committee; and it was in the form of a recommendation by these Committees that the matter now came up. The costs that were in question were costs of proceeding to certain definite stages in certain actions, and costs incurred upon summonses and so forth, which, under the arrangement with Hunter and his solicitors, the Corporation were to be repaid. The costs consisted chiefly of costs for his labour and time, and partly of payments out of pocket. The costs as made up came to nearly £400; but the amount stated by Mr. Rycroft represented the approximate amount they would get on taxation. He did not think that on taxation they would get more than £250 at the outside. Hunter absolutely refused to pay any part of the amount; so that if they wanted to recover it, they would have to take action. What Hunter's defence would be, he did not know. Possibly he might go into the whole question. Till he knew what Hunter's defence was, he could not say whether or not the Corporation would succeed.

Alderman M'KERROW remarked that he had considerable sympathy with the position taken up by Mr. Mandley in this matter. He did not think it would be wise for the Council to tamely submit to the writing off of these costs. If it was true that Hunter was appearing in public in betting and sporting circles, he did not see why the Corporation should have any delicacy about insisting on their just rights. He thought they would be blamed by the public if they were to quietly retreat and withdraw their claim because Hunter and his solicitors showed fight.

The MAYOR said the question was looked at all round not only in the Consultative Committee, but in the General Purposes Committee; and they came to the conclusion that the wisest course to take was to wipe the whole thing off. If they were to go to law for the costs, they would simply be throwing good money after bad.

The TOWN CLERK, in answer to Mr. Sharrocks, stated that he had the personal undertaking of the solicitors for the payment of the money, so that, if it should be decided to take action, it was possible he would have to proceed both against solicitors and client.

Alderman DICKINS observed that the Corporation would lose more than £250 by bringing such an action as was proposed. It might be a long and costly litigation; and he did not see what they were to gain by it. It would not throw any further light on the gas frauds.

Mr. RYCROFT, in replying on the discussion, said it was too late in the day to consider the taking of action against the contractors, who had been already released. He questioned whether they would succeed if they took action against Hunter or his solicitors. They would probably plead, and plead successfully, that the agreement under which they sought to recover these costs was an illegal one.

On a division, 14 members voted for the resolution and 27 against.

The MAYOR said he supposed it was understood by the Council that proceedings would be at once taken by the Town Clerk to recover this sum.

The TOWN CLERK remarked that he would do that without any further resolution.

Alleged Incendiarism at a Spanish Gas-Works.—According to a Reuter's telegram which appeared in the *Standard* last Friday week, a holder at the gas-works at Tolosa, near San Sebastian, was maliciously fired on the night of the 6th inst., by some person who has not been discovered. One night watchman was severely burned. It is stated that 30 cases of petroleum were stored near the holder; but they were removed to a safe distance before they could be reached by the fire.

THE ELECTRIC LIGHTING QUESTION IN BRUSSELS.

An esteemed correspondent in Brussels has forwarded to us a long letter on gas and electric lighting affairs in Belgium. He deals first with the electric lighting scheme which has just been adopted for Brussels, the carrying out of which has, it will be remembered, been entrusted to an English Company.

The electric lighting question, writes our correspondent, appears to be settled at last; but its solution is not that which was hoped for by the tenderers, as the members of the Council have, by a unanimous vote, decided that the undertaking shall be conducted by the Municipality itself. They have further determined that the matter shall be referred again to the Finance Committee; and consequently some time must elapse before work can be started. The report of the Electrical Engineer of the City (M. Wybauw) favouring the tender of the India-Rubber and Gutta-Percha Company has been the subject of numerous remarks on the part of certain members of the Council. M. Bède, the well-known electrician, has criticized the Company's project, which, according to him, is too onerous. He asserts that the question has not been properly considered, that all the necessary guarantees have not been obtained, and that the whole thing should be dealt with *de novo*. He favours a different solution of the problem; and proposes to start a central station by way of experiment, and afterwards to extend the lighting to the most distant points. Such a station would, he makes out, entail an outlay of only about 1,300,000 frs.; while according to the system adopted by the Technical Commission, the distribution of electricity within a certain radius would cost 1,600,000 frs. for 9000 lamps, and 3,000,000 frs. for the complete lighting of the city, which would require at least 20,000 lamps. On the other hand, M. Van Rysselberghe has asked that a final decision shall be postponed, seeing that his system of lighting has been adopted in Antwerp, and will soon be in operation; thus affording the Brussels authorities an opportunity of witnessing the results of his experiment before commencing work in the capital. He, too, is persuaded that the approved scheme is onerous and impracticable. The Burgomaster combats the views of these two engineers. He recalls the fact that the electric lighting question has been under the consideration of the Council for nearly four years, and that it is now quite time that they should come to a decision, and accept the responsibility of it. This way of looking at the matter has the support of the Sheriff of Public Works, who, referring to the criticisms of M. Béde, says it is out of the question to suppose that the specialists who were consulted—M. Wybauw and his colleagues—are all simpletons. Nothwithstanding this sally, M. Béde maintains that the question has not been fully studied, and that specious considerations have caused the adoption of the proposals of the English Company. In this, says our correspondent, the worthy councillor does not seem to be altogether in the wrong; for the discussion as to whether the distribution of the electricity when generated should be undertaken by the Municipality or handed over to a Company showed clearly that the Committee who had to come to a decision upon the tenders submitted did not obtain all the guarantees necessary for so important an undertaking. The Municipality recognize that they cannot discontinue to interest themselves in the matter of the lighting of the city, which constitutes a public service. They will have at heart the keeping of the lighting abreast of whatever progress may be made in the domain of electricity, and may permit of the reduction of the price charged to the consumers. It is not to a company that this important duty should be entrusted, seeing that contracts would be entered into which would prevent any action whatever being taken in respect of the parties carrying on the undertaking. This would create a dangerous monopoly, with which the city would be saddled for 25 years under conditions that would be disadvantageous to its finances, if at the end of this period it intended to take up the working of the concern. It would appear from all this that the combination upon which the Commission have decided is not in all respects advantageous; and that, even if it is the arrangement preferred by the Electrical Engineer, it is none the less open to the attacks of critics. The Sheriff of Public Works has furnished a few explanations on the subject of the delays which have occurred in the settlement of this question—delays of which complaint has been made from time to time. According to him, they have been to a great extent caused by the necessity for obtaining all the latest information upon a question so complicated as that of lighting by electricity. The public would have been wrong in thinking that the Council had come to the conclusion to nip the project in the bud, at the same time satisfying the partisans of electricity to a certain extent by pretending to make an adjudication. The Technical Commission, consisting of three engineer experts, set themselves seriously to work; and if they threw some little mystery into their deliberations, they did so apparently in order to escape as effectually as possible from the influences to which some of the competitors might have had recourse, with the view of affecting their decision. Electric lighting having now been declared to be a matter of public utility in Brussels, if the Finance Committee ratify the agreement with the India-Rubber and Gutta-Percha Company, the discussion of the question will be closed, and the city will be able to "make haste slowly" to do the rest. Although it may not show itself to be systematically hostile to the new light, there is good ground for supposing that it does not purpose withdrawing the favour accorded to gas, in order to bestow it upon an undertaking which will first of all have to prove its worth; for the city draws from its gas-works something like a million francs per annum. Members of the Council will have an opportunity of appreciating the value of this revenue when very shortly the discussion of the municipal budget becomes the order of the day. The word will be given to say as little as possible about arc and incandescent lamps, so that competition with the existing lighting service, which renders such valuable aid in establishing the financial equilibrium, may be deferred as long as possible. According to the opinion of a functionary who is in a position to know what is on the cards, the matter will be carefully "pigeon-holed," and the city will dispense with the electric light. In fact, there has been a change in public opinion on this question; and it is the inhabitants of Brussels, and not the communal administration, who are now opposed to the installation. As soon as a man learns that electricity will cost, at the outset, twice

as much as gas, he begins to think about the matter. The announcement of this increase in expense has put a damper even upon the partisans of the new light. Then people recall to mind that it is an English Company on whom it is proposed to confer the privilege of furnishing the installation; and this fact is not agreeable to the Chauvinists and Protectionists. Further—and this is better than all—the City Engineer, in his turn, utters a note of discontent on the subject of the location of the central station, as indicated by the Technical Commission. In his opinion, the Place St. Catherine is unsuitable for the establishment of a central station such as he has had in mind. This is the position of the electric light question in Brussels.

Since the foregoing was written, news has reached us from another correspondent of an incident which occurred at the meeting of the Finance Committee of the Municipality on the 9th inst. The Committee were called together to consider the financial questions connected with the electric lighting scheme; but before commencing the business, the Burgomaster read a letter received from M. Boty, representing the India-Rubber and Gutta-Percha Company, in which he stated that M. Bède, who, as mentioned above, has condemned that Company's system of supply, had asked him to assist in enabling him to obtain the electric lighting installation at the Grand Hotel. M. Boty refused to accede to the request; remarking that the consequence of M. Bède's proposition would be to take from the city a customer bringing in 50,000 frs. annually. After the reading of the letter, the Committee deemed it advisable to have M. Boty before them. He accordingly attended, and confirmed verbally his written declarations. M. Bède protested that his intentions were perfectly honourable. The Burgomaster remarked that he thought M. Bède's conduct was wanting in propriety. M. Richald, for himself and M. Vandendorpe, said he should decline to sit with M. Bède, who was called upon by M. Allard to send in his resignation. All the other members present concurred that this was the right course to take; and the sitting was abruptly closed.

ELECTRIC LIGHTING FOR SYDNEY.

At a recent Meeting of the Engineering Association of New South Wales, Mr. A. W. Tournay-Hinde read a paper on the "Electric Lighting of Sydney and its Suburbs." He stated at the outset that, as he had not had any actual experience of lighting such large areas as the City of Sydney and its suburbs by means of electricity supplied from central stations, and as he only possessed a knowledge of some of the principal means that could be employed for the purpose, his excuse for reading the paper must be that he was anxious that the discussion which he hoped would ensue would tend to thoroughly investigate the merits and demerits of the systems that could be employed before the inhabitants of Sydney were committed to any one particular scheme. Whenever a change was made from an existing custom or method of carrying out any particular work, there should be valid reasons for the change; and, therefore, before relinquishing the present method of illuminating the streets and highways, the inhabitants should pause to consider the advantages and benefits likely to accrue therefrom. Having referred to the arc lighting in one of the principal streets of the city, in which there are ten large arc lamps in a distance of about 100 yards, Mr. Tournay-Hinde said this sample of electric lighting gave people some idea of the superiority of arc lamps for city street illumination in comparison with gas-lamps. It might, he said, be urged that lighting by arc lamps cost more than the present gas-lamps; but it must not be forgotten that the proportion of light given was far in excess of that of the cost, and that per candle power it was much cheaper. In the minor suburban streets, where the lighting would probably be carried out by means of incandescent lamps, the advantages were not so striking, as, light for light with gas-lamps, the cost was about the same as that now paid for gas. It was, however, for interior illumination that the incandescent lamp excelled; in a climate such as that of Sydney, where the heat on summer evenings was at times almost unbearable, anything that would add to the comfort of the inhabitants must at once, when known, be greatly appreciated. Figures went to prove, and experience in the past had shown, that street lighting without house-to-house lighting was not, commercially speaking, a profitable undertaking. Street lamps were too scattered in relation to the extent of mains necessary for supplying them. His hearers should therefore dismiss from their minds any idea of lighting the streets only. In addition to the cost of electricity, there was the cost of lamp maintenance. In Sydney, the price of lamps suitable for house lighting was 5s. each; but by the time that Sydney was in the enjoyment of the electric light, the patent rights which now so enormously increased the manufactured price of these lamps would have lapsed, and they would probably be sold at a price varying from 1s. to 2s. each. Up to the present time, all the proposals made up for the electric lighting of Sydney or its suburbs had limited the area of supply to either the city or the area comprised within one of the outlying municipalities; and no suggestion, so far as he was aware, had been made for a comprehensive system large enough to serve the whole of Sydney and its principal suburbs. It undoubtedly appeared at first sight to be a large order; and, if controlled by a single company, it would mean a great expenditure of capital, and at the same time a huge monopoly. The number of dwellings and tenements in the city of Sydney and the adjoining suburbs was about 69,000. If they allowed that in 10 per cent. of these the inhabitants would still retain their old methods of lighting, the total was reduced to about 62,000. Presuming that, on an average, each dwelling would not have more than 38 watt lamps alight at one time, the total force necessary to maintain these, allowing for losses in transmission, generating, &c., would be between 30,000 and 40,000 indicated horse power. There are 115 miles of made streets in Sydney, and 573 miles in the adjacent districts. Allowing that in Sydney 50 out of the 115 miles would require lighting by means of arc lamps, and in the suburbs 200 out of the 573 miles, the length of streets lighted by arc lamps would be 250 miles. With 20 lamps to the mile, the total number of arc lamps would be 5000, and would require between 5000 and 5500 indicated horse power for their lighting. The remaining 438 miles, if lighted with 25-candle incandescent lamps, placed at varying distances apart, according to the locality—say, to give an average of about 27 to the mile—would require about 12,000 indicated horse power at the supply station. The power would then total as follows: House-to-house, say, 40,000; streets lighted by arc lamps, 5500; streets lighted by 25-candle incandescent lamps, 12,000—total, 57,500. Having described the area over which the amount of current generated by this power would be utilized, Mr. Tournay-Hinde went on to say that the question of supply and distribution reduced itself to this—that it was necessary to have a network of low-tension mains for supplying the houses, fed at different points by high-tension currents by means of some kind of transformer. To his mind, it appeared that if the lighting of Sydney and its suburbs were carried out and afterwards controlled by a Board of Commissioners in the same way as the railways, and if similar supervision were brought to bear on all wiring firms, as was done by the Water and Sewerage Board in the case of the plumbers, it would secure to the general public a system of supply that could not fall to their lot by any other means. With so large a system as that suggested in the paper, the difference in the original cost of plant, if carried out in accordance with any particular system as contrasted with another, might be so small as to be unworthy of consideration when the most important point—viz., that which would best serve the varied requirements of the public—was taken into account.

THE LIVERPOOL CORPORATION VYRNWY WATER SUPPLY.

Inauguration by the Duke of Connaught.

Last Thursday was an important day at Liverpool, for it marked the completion of the great Vyrnwy water undertaking. The Corporation had resolved that the act of turning on the water should be a public one; that it should take place in front of St. George's Hall; and that it should be accompanied by that ceremony which the importance of the event demanded. With this view H.R.H. the Duke of Connaught was requested to visit Liverpool; and to this he cheerfully assented. Many of the principal streets were gay with flags and banners; and the greatest enthusiasm prevailed throughout the day.

Shortly before one o'clock the Duke and party arrived at St. George's Hall, where the Recorder (Mr. C. H. Hopwood, Q.C.) read from a silken scroll, contained in a silver casket, an address of welcome signed by the Mayor (Mr. J. de Bels Adam). In this reference was first made to a previous visit of His Royal Highness, when he opened the Sefton Park and the Royal Southern Hospital, both of which undertakings have proved to be of the greatest advantage to the community. The address then proceeded: "We, therefore, regard it as a circumstance of happy augury that your Royal Highness should have kindly consented to be present to-day at the completion of another great public work, which, although differing from the two undertakings previously honoured by your patronage, is of the utmost importance to the city. The necessity of ensuring a constant provision of pure and wholesome water—so essential to the interests of the public health and of commercial enterprise—has for many years occupied the anxious attention of the Council; and now at considerable cost, and after surmounting engineering difficulties of no ordinary magnitude, we have succeeded in obtaining from Lake Vyrnwy, in the Principality, a supply which—being practically unlimited—will be amply sufficient for the requirements of Liverpool and many adjacent districts. It is a source of satisfaction to us, and we venture to think that it will be one of pleasure to your Royal Highness, that you should thus be personally identified with three undertakings so closely connected with the welfare of Liverpool." In his reply, the Duke alluded to the cordial welcome which had been given him, and expressed the pleasure he felt at again having the opportunity of becoming associated with another of the great public works of Liverpool. He added: "The importance of so vast an undertaking for providing an inexhaustible supply of pure water for this city has been most wisely recognized by the Liverpool Council; and I heartily congratulate the members and those associated with this magnificent enterprise upon its successful completion. Among the many important works that have been undertaken by different municipalities, none have so far excelled this for boldness of conception and for thoroughness of execution; and the benefits arising from this supply of excellent water from Lake Vyrnwy will, I trust, be marked by the increased health and prosperity of the inhabitants of Liverpool."

His Royal Highness, the civil officers, and the rest of the company present, then proceeded to the east side of the hall, where the water was to be turned on. Alderman John Hughes, as Chairman of the Water Committee, introduced the ceremony by a speech descriptive of the progress and importance of the scheme. He said that the water supply of Liverpool and of the district had been under the control of the Corporation since 1847. Up to that year the water-works were in the possession of private Companies, who obtained water from wells, sunk in the new red sandstone on which the city was built. The supply given by the Companies was very inadequate; the water only being allowed to be on for two or three hours a day, and that only once or twice a week. When the Corporation acquired the works, they came under obligation to provide such a supply as would permit of water being constantly laid on to every house within the limits. To enable them to accomplish what they had undertaken, it became necessary to obtain a very much larger quantity of water than was then available. Many schemes were suggested and investigated; and ultimately a large tract of wild moorland in the hilly country between Bolton and Blackburn in this county was selected as the source of supply. In the valleys below these hills, extensive reservoirs had been constructed, capable of holding upwards of 4000 million gallons of water. These reservoirs extended upwards of five miles. The rivers and streams which flowed into these reservoirs yielded water of an excellent quality, especially adapted to the needs of Liverpool; and this was the scheme known as the Rivington water supply. This supply was brought into Liverpool in the summer of 1857, or 35 years ago; and it was then expected that it would satisfy the requirements of Liverpool for a long future. In less than ten years, the yield of Rivington and the wells proved insufficient to meet the demands

of dry seasons; and although the Corporation had spent more than £2,000,000 on their water supply, there was already a scarcity. The growth of population and trade demands was very rapid; and the spread of new sanitary ideas and appliances led to a constantly increasing use of water. For some years the deficiency was met by making extra reservoirs and sinking additional wells, and also by restricting the distribution and checking waste. In the meantime, the examination of new sources of supply was vigorously proceeded with. The Council, warned by previous experience, resolved that any scheme adopted by them should not only be sufficient to supply Liverpool for at least 30 years, but should also be capable of being extended in such a manner as to satisfy any demands that could possibly be foreshadowed. Ultimately, and after protracted inquiry, the Vyrnwy scheme was chosen; and the Royal Assent was given on Aug. 6, 1880, to a Bill for carrying out these works. In selecting this scheme, the Corporation had the benefit of the labours of a Royal Commission, presided over by the Duke of Richmond, which in 1866-7 reported on the Vyrnwy Valley as part of a scheme recommended by an eminent Engineer—the late Mr. J. F. Bateman—for the supply of London. The principal features of the Vyrnwy works as carried out by the Corporation were: A reservoir in the Vyrnwy Valley among the Berwyn Mountains nearly six miles in length by half a mile in width. This reservoir was formed by the building of a massive masonry wall across a narrow part of the valley. This wall was 1172 feet long at the top; and its extreme height was 161 feet from the lowest part of the foundation to the parapet of the carriage way. The greatest depth of water was 84 feet. When full, the reservoir would hold more than 13,000 million gallons of water. When the scheme was fully developed, the reservoir would receive the rainfall from 23,200 acres of watershed; and the quantity of water which this gathering ground would yield would be sufficient to give to Liverpool a supply of 40 million gallons a day, after sending down the River Vyrnwy the compensation water, which, under the Act of Parliament, the Corporation were bound to deliver in aid of the River Severn, and which compensation amounted to 13½ million gallons of water per day. To convey the water from Vyrnwy to Liverpool, the Corporation had constructed an aqueduct 68 miles in length, terminating at Prescot, a distance of eight miles from the city. About four miles of the aqueduct was in tunnel, capable of carrying the full supply of 40 million gallons per day; but for the remaining 64 miles iron pipes had been laid to carry one-third of the ultimate quantity, or 13 million gallons per day. The additional lines of pipes will only be laid as the demand for water increases. The whole of the water would be filtered through sand filter-beds, which have been constructed near Oswestry, in Salop. The surface level of the Vyrnwy reservoir was 825 feet above Ordnance datum —that was above sea level at Liverpool; and the water was delivered at Prescot at an elevation of 275 feet above Ordnance datum; 550 feet of head were therefore expended in carrying the water by gravitation along the aqueduct. For engineering purposes the aqueduct was divided into six sections, in each of which a balancing reservoir was placed for the purpose of regulating the pressure or head of water. The most difficult and tedious part of the aqueduct had been the crossing of the River Mersey. Here the Corporation, owing to the opposition of Warrington and riparian owners on the Mersey, were compelled to form a tunnel through ground, and under conditions which made the driving of a tunnel not only very difficult and slow to carry out, but entailed upon the Corporation a large extra outlay which was not contemplated in the original scheme. The difficulties had, however, been surmounted, and the water had been successfully conveyed across; and in carrying out these works Mr. G. F. Deacon, the Engineer, had shown an amount of ability, skill, and energy which stamped him as an Engineer of the highest order, and to whom Liverpool was very much indebted, and to him (Alderman Hughes) it was a source of very great pleasure to bear testimony to the able, persevering, and successful efforts of that gentleman. The immediate effect of the operations which he had shortly detailed was that the Corporation were now in a position to command a supply of more than 30 million gallons of water per day, or sufficient to supply the requirements of 1,200,000 people. When the Vyrnwy works had been fully developed, the water resources of the Corporation would be sufficient for the necessities and requirements of a population of at least 2,300,000. The actual population now within the Liverpool area of supply was between 800,000 and 900,000. The actual average consumption of water per day was 20 million gallons. He should not be doing justice if he did not also refer to the Water Committee. It had been his practice as Chairman to take the Committee fully into confidence in all the difficulties, the perplexities, and complications which, in a scheme of this magnitude, were unavoidable; and he might be permitted to say that the members had worked together assiduously and disinterestedly for the success of the scheme and the welfare of the city. There had, of course, been moments when the enthusiasm of some of the members kindled in them the idea that they knew better than the Engineers; and he believed one or two would cheerfully have taken the management, not merely from the Chairman, but from the contractors and the Engineers. But these moments of zeal were transitory; and eventually these gentlemen permitted the scheme to be continued and to be presented to-day as a monument to the enterprise of the great City of Liverpool. He had to make an addition, and that was to say that he was informed by Mr. Deacon that 14½ million gallons of water had that day passed through the pipes at Fiddler's Ferry.

His Royal Highness afterwards pressed an electric button, and immediately two huge volumes of water sprang up from the fountains below to the height of 50 or 60 feet. The Mayor presented to the Duke a silver goblet containing Vyrnwy water; and, amid much cheering, his Royal Highness took a deep draught of the liquid. His example was followed by the Mayor and Mayoress. Mr. Deacon and Mr. Parry were then presented to the Duke by the Mayor. Subsequently His Highness and a large company were entertained at luncheon by the Mayor in the Town Hall.

In the evening the temporary fountains which had been erected outside St. George's Hall were illuminated, and firework displays were given in the park.

SHEFFIELD CORPORATION WATER SUPPLY.

The Position of the Accounts and the Twenty-five per Cent. Addition to the Water-Rates—Successful Working of the Department.

The Water Committee of the Sheffield Corporation have lately published an important report on the subject of the 25 per cent. which was added to the water-rates by the Sheffield Water-Works (Inundation) Act of 1864, and which continues until the end of 1894 by the Corporation Act of 1887. The document reads as follows:—

The Council having approved of the Committee's intention (expressed in their resolution of March 2 last) to proceed at once to consider the estimated position of the accounts of the Water Department after the year 1894, in view of the termination on Dec. 31, 1894, of the period during which the water-rates as charged previous to 1864 stand increased by 25 per cent., the Committee have carefully considered the obligation upon the Corporation to pay the sinking fund (by which the water undertaking is being absolutely bought out and the debts thereupon gradually discharged out of revenue), and the effect of that obligation, coupled with the annual charge for maintenance of the works, and the payment of annuities and interest and other necessary outgoings.

The Committee have arrived at the following conclusions: (1) That the ordinary revenues of the undertaking are ample for discharging all obligations usually coming against revenue account; and to bear the reduction of the whole of the 25 per cent. at the proper date (Dec. 31, 1894), and also to yield a considerable surplus towards the discharge of the capital purchase. But (2) inasmuch as the freehold of the undertaking (a capital purchase, including annual increases, of more than £2,200,000) has to be bought up by instalments of about £5500 per year, chargeable also upon revenue account, it is not possible, nor could it be reasonably expected, that the whole of this could be accomplished out of the profits of the undertaking. But still (3) that all the said requirements, and the redemption of the whole freehold of the undertaking is calculated, and may be fairly expected to be accomplished, by an extension of the 25 per cent., or part of it, for a period very short only when compared with the vast property to be acquired. And (4) that, such being the case, the Committee advise that the freehold purchase or sinking fund be provided for in that manner, rather than enter upon the question of doing so out of the district fund, or any of the rates or other income of the Corporation; and that, accordingly, the Council should seek statutory power to extend somewhat the period during which the water-rates may be maintained, first for a short time at their present scale, and then, for a few years, at a reduced scale, before falling back altogether to the scale in force previous to 1864.

Before setting forth the scheme which they propose as an alternative to an absolute reduction of the water-rates by the 25 per cent. at the end of the year 1894, the Committee think it will further explain why the Corporation cannot, with a due regard to the circumstances of the case, at that date reduce the rates by the percentage in question, especially as, in promoting the Bill for the Corporation Water Act, and opposing the Bill promoted by the late Water Company for maintaining the 25 per cent. in perpetuity, it was urged on behalf of the Corporation that, if the latter became possessed of the undertaking, they would probably be able soon afterwards absolutely to remove the 25 per cent. The expectations of that time, upon which the purchase was recommended, have indeed been more than realized; for, as has already been stated, and as is shown by the printed accounts, the ordinary revenues are calculated to be sufficient not only to bear reduction after 1894 of the whole 25 per cent. alluded to, in addition to all ordinary charges, and other important charges which will be referred to, but also to cover, as it is calculated, by far the greatest part of the sinking fund, or purchase of the freehold. And the Committee would beg to call attention to the contrast between this result of the Corporation purchase and the proposal hereafter set forth on the one hand, and, on the other hand, to the proposal of the late Water Company, which was to maintain the whole of the 25 per cent. in perpetuity, and that entirely for the benefit of the members of the Company, and without any reduction whatever of the capital debt of the undertaking.

The Committee would call attention to the following extract from the decision of the House of Lords' Committee when they came to the conclusion that the Corporation Bill was proved—viz., "The Committee have come to a decision that it is expedient that the water-works of the Sheffield Water Company and the control of the water supply should be transferred to the Corporation. They have come to this conclusion on the grounds of public policy. But they do not consider that there has been any proof of mismanagement or failure of duty on the part of the Sheffield Water Company; and they think, therefore, that the terms of purchase should be not only fair, but liberal. They are accordingly of opinion that, in fixing the price at which the Company's works shall be taken over, the arbitrator shall calculate their value as though the additional 25 per cent. rate, expiring in the year 1889, had been continued for five additional years." The obligation laid upon the Corporation by that decision of the House of Lords' Committee, compelled them not only to ask that the Corporation Act might contain a section continuing the 25 per cent. for the five years referred to in the decision, but also to pay a much larger sum for purchase of the undertaking than they expected when urging the promotion of the Bill. The purchase, as the Council will remember, represented a capital sum of £2,088,872, for payment of which the Corporation have had to provide an annual contribution to a sinking fund (about £5500 per year), as well as the interest on the purchase money and additional capital since expended and the expenses of management.

It is a source of great satisfaction to the Committee that they are able to point to the result of the undertaking in the hands of the Corporation; the last year showing that, after payment of all charges upon revenue and the sinking fund, there was an actual surplus of £1976. The accumulated deficiency on revenue account on March 25, 1892, amounted to £5562; while the capital of the undertaking has been liquidated by the contributions to sinking fund, amounting to the total sum of £24,084. It should be borne in mind that this result is attained

after charging against revenue increased rates and taxes settled by agreement, cost of special treatment of Redmires water (proposed, by the Company's Bill of 1887, to be made the subject of additional heavy charges), interest on additional capital raised since the transfer, and also proportion of salaries, and interest on unproductive works previously charged to capital, as well as increased profit to the shareholders' which, with the Corporation guarantee, has greatly increased the capital value of their shares. If no provision for sinking fund had been made, and the capital of the undertaking remained a permanent charge on the water supply of the town (as was the case under the Company), then it is apparent, after deducting the accumulated deficiency of £5562 from the sum of £24,084—the amount provided for the sinking fund—that a sum of £18,522 would have accrued from the purchase to March 25, 1892, for disposal by the Council, and which sum, but for the Corporation purchase, the late Company would have paid out to, or held to the credit of, the shareholders. As a matter of fact, however, such amount of profit has been earned, appropriated, and invested for the benefit of the town, in spite of the pressure of the above-named additional charges.

These results are such as to prove that, if there were either no obligation compelling the Corporation to reduce the water-rates at the end of 1894, or no obligation to purchase the freehold out of revenue, the prospects of the undertaking are most satisfactory, and would not lead to the necessity for considering any change in the statutory powers relating to it. Inasmuch, however, as the former obligation will cause a fall of upwards of £20,000 in the annual water-rates, it is clear that the reduction cannot be effected without giving a very serious blow to the financial position of the undertaking, unless subsidies from some other source are provided to make up the deficiency caused by the reduction. That being the case, the Committee have very carefully considered a number of tables showing various modes of dealing with the difficulty caused by the required reduction of the 25 per cent.; and they recommend that the Council should seek statutory power to maintain the whole or any part of the 25 per cent. increase in the rates made by the Act of 1864, on all or any of the classes of water supply—*i.e.*, domestic and trade—at the discretion of the Corporation for a period not exceeding three years from Dec. 31, 1894, and thenceforth to maintain so much, but not exceeding one-half, of the 25 per cent. as the Corporation may from time to time require on all or any of the classes of water supply for a further period of not more than eight years—that is to say, not beyond the year 1905.

If these suggestions are adopted, and power be obtained to put them into force, the effect would be as follows: Assume the retention of the present water-rates for two years only, instead of the maximum of three years for which authority is proposed to be asked, beyond the year 1894—*i.e.*, until Dec. 31, 1896—it is estimated the present deficiency will be wiped out, and a surplus accrue, after providing sinking fund, amounting at that date to a total sum of over £13,000, sufficient, subject to contingencies, to warrant a reduction of one-half of the 25 per cent. upon all classes of water-rates, which would involve an immediate loss in the water revenue of upwards of £10,000 per annum. If the estimated ratio of increase in the earning capacity of the undertaking be then still maintained, a sufficient surplus would have accumulated to permit the relinquishment of the second half of the 25 per cent. in the year 1905, and still carry forward a considerable surplus. The water-rate charges will then revert to those payable under the powers of the Sheffield Water-Works Act, 1853, as charged until 1864.

There is a gradually accumulating surplus, which at the end of the year 1909 is then estimated to amount to a total of £26,498; and it might be inferred that a reduction earlier even than 1905 of the second half of the 25 per cent. is possible. Such may, indeed, possibly be the case; but it should be borne in mind (1) that these calculations are subject to large contingencies, and should, therefore, be ample on the side of safety, and (2) that it is estimated that in 1909 the resources of supply of the existing water-works will have become exhausted, and that the complete extended works must then be sufficient to afford an ample and continuous supply of water. The surplus above referred to will, therefore, be required for the purpose of providing the interest and sinking fund upon additional capital during the construction of the first portion of the Ewden scheme, commencing in the year 1905.

Inasmuch as the above calculations are based upon the assumption that the requisite instalments to sinking fund continue to be provided out of the revenue of the water undertaking, the result may be stated thus: That, in return simply for the retention of the 25 per cent. for probably only two, and at most not exceeding three years, from Dec. 31, 1894, and one-half of the 25 per cent. for a further period not exceeding eight years—*i.e.*, not beyond the year 1905—which said retentions amount to a maximum total of £152,418 (or of £129,760, if the whole of the 25 per cent. be retained for two years only), the whole water-works, of £2,145,336 capital value, with all additional capital expenditure estimated to be incurred to the year 1909, amounting to £165,000—*i.e.*, a capital value of £2,310,336 in all—would be acquired by the town, with an estimated surplus of £26,498 to carry forward to the cost of the Ewden scheme. The whole of this £2,310,336, excepting the above-named sums of £152,418 or £129,760—say, £2,157,918—is thus calculated to be provided out of the natural revenue of the undertaking, in addition to the advantage of a return to the water-rates of before 1864; whereas, if the Company's Bill of 1887 had been passed, the whole of this estimated capital of £2,157,918, besides a sum of upwards of £20,000 every year in the perpetual retention of the 25 per cent., and increased water-rate charges for remedy against liability to lead-poisoning, would have been taken from the town for the private profit of the shareholders of the Company.

The Committee, therefore, beg to recommend the Council to apply for an Act of Parliament to carry out the foregoing recommendations; also at the same time to apply for an extension for a further period of the obligation to construct the water-works in the Ewden valley, as the existing period will, according to the Sheffield Water Act, 1881, expire in the year 1900.

At the meeting of the Town Council at which the minutes of the Water Committee containing the above report were presented for confirmation, Mr. Bennett moved, as an amendment—"That so much of the acts and proceedings of the Water Committee as relate to the intended application to Parliament for additional or extended powers be not confirmed, but be referred back to the Committee, with instructions to insert in any application to Parliament provisions to provide that the charge for water supplied for water-closets be included in the charge for water supply for ordinary purposes, and, if necessary, to provide that the Health Committee shall pay to the Water Committee such sum as may be agreed upon to cover the cost of the water so supplied." Mr. Jackson having seconded the amendment, the Mayor (Alderman J. Gamble) pointed out that the Water Committee were getting into a better position with their accounts; and he asked that they might be allowed more breathing time before they went further. The Town Clerk expressed the opinion that it would be a foolish thing to adopt the amendment; and, on being put to the vote, it was rejected by a considerable majority. A general statement was then made by Alderman Gainsford as to the operations of the water undertaking since it came into the hands of the Corporation. He said, comparing the year ending March last with that ending March, 1887, they had had a total increase of revenue from all sources of £20,452. This amount was made up in three ways—there was an increase of £13,244 in receipts from water and other sources; there was, he was happy to say, a decrease of £1132 in working expenses; and there was £6076 reduction, which had come through the borrowing of money on security of the Corporation. For the latter, they had to thank the Finance Committee. The £20,452 had been disposed of in this way. Increased profit paid to ordinary shareholders, £4720; salaries, previously charged to capital but now charged to revenue, £700; interest on works in progress, previously charged to capital but now charged to revenue, £2280; interest on £52,175 cash paid on taking over, and on £56,848 expended on additional works, £3270; additional payment settled by agreement towards local rates, £1529; cost of special treatment of the Redmires water, £344; paid to sinking fund, instalment of purchase-money paid off, £5634—leaving a surplus on the year's working of £1975. The increase in the revenue from the consumption of water was £2562 yearly, on the average, during the five years from 1867 to 1872; from 1872 to 1877, it was £2437; from 1877 to 1882, £1455; and from 1882 to 1887, £1780; but during the last five years, when the works had been under the control of the Corporation, the average annual increase had been no less than £3121. This proved that, under Corporation management, the water had been freely used for the benefit of the town. In considering the proposed extension of the 25 per cent. for two or three years, and afterwards of half the 25 per cent. for eight years, he asked the Council to bear in mind what would have been the result if the Water Company's proposals had received parliamentary sanction—viz., the 25 per cent. in perpetuity, and a further possible increase in water-rates, amounting in some instances to 30 per cent., to cover the cost of filtration; the latter being proposed to meet the outcry as to lead-poisoning, which the Committee had remedied at an annual cost of £344. The minutes were then confirmed.

CITY OF ST. PETERSBURG NEW WATER-WORKS COMPANY, LIMITED.

The Purchase of the Works by the Municipality.

An Extraordinary General Meeting of the above Company was held last Thursday, at the Cannon Street Hotel, E.C.—Mr. W. T. Western in the chair—to consider, and, if thought fit, to pass a resolution authorizing the Directors to sell the Company's works in the transfluvial districts of St. Petersburg to the Municipality, and with a view to effecting such sale, empowering them to appoint such persons as they may select to act as the agents of the Company for negotiating and concluding the terms of sale, and for signing on the Company's behalf the contract for sale; to restrict the powers and authorities of the agents as the Directors may think fit; and to carry into effect any contract made by the agents, with or without modification, as the Directors may think expedient.

The Secretary (Mr. F. Grant) having read the notice convening the meeting,

The Chairman moved the adoption of the resolution summarized above. In doing so, he said the shareholders had been called together to confer upon the Directors full powers for the sale to the Municipality of their works in St. Petersburg. The question they had to decide was not whether they were going to sell the undertaking, as the Douma had the right to take the works over after a certain date, upon giving the Company sufficient notice that they intended to exercise this right; but what they had to settle was the price that was to be paid for the property. The main lines upon which the purchase of the undertaking was to be based were fixed by the concession; and practically it was to be upon the revenue of the last year of the Company's working. There were two ways of determining the purchase-money—by mutual agreement between the town and the Company, or by arbitration. Both the Douma and the Directors were desirous of avoiding all the trouble and expense of arbitration, Then there were two methods by which they could pay the money—by an annuity to run until the end of the concession (about 25 years); or, in lieu of that, by a capital sum down. But, beyond this, several questions were likely to arise which it would be necessary to dispose of before the purchase-money could be ascertained. In the first place, the town wished to make the date of the transfer the 1st of January, 1893. It was manifest that they could not tell what the revenue of 1892 would be on that date; it would be February or March before they could get out the accounts. The way in which the Directors therefore proposed to calculate the amount was to take the 1891 accounts as a basis, and add on to the revenue an agreed sum for the possible increase of the current year. The Water Committee of the Douma had had before them the Company's balance-sheets for the last seven years; and they had made their preliminary calculations upon them. One important and thorny question which had arisen was as to the value of the extra works that had been constructed over and above the original contract, and which of them were to be paid for. To elucidate these various questions, the Douma had appointed a Committee to negotiate and settle the figures with representatives

of the Company. So far the negotiations had gone on in a perfectly amicable way; and this led the Directors to hope they would arrive at a fair conclusion. The Douma were anxious that the matter might be arranged, so that the whole transaction could be completed on Jan. 1 next. Having stated that it would be distinctly to the advantage of the town to pay a lump sum to the Company, the Chairman proceeded to observe that he supposed the shareholders would expect to hear something as to their calculations. But this was a rather delicate and difficult matter; and he must be a little reticent on the subject at present. The best information he could give them as to the value of the undertaking was that stated in the report of the Water Committee of the Douma. They had taken the accounts for the past seven years; and the value they had placed upon the undertaking was 2,200,000 roubles, subject to the verification of the accounts. The sum the Directors were asking was somewhat larger; but there was reasonable expectation they would come to a fair arrangement. As to the debts of the Company, they had £120,000 upon debentures, *plus* certain arrears of interest; but the current revenue of the year, assuming it ran on to Dec. 31 next, would about wipe off the arrears, and they would stand with a level capital account.

Mr. R. S. GUINNESS seconded the motion.

The CHAIRMAN, in answer to questions, said the Company's contract with the town was not in gold, but in roubles; so that they would have to take the risk of the exchange in bringing the purchase-money home. The Russian law generally did not recognize bargains made in any other but their own currency.

The resolution was agreed to; and a vote of confidence in the Directors was afterwards unanimously passed.

The Meteor High-Power Gas-Lamp.—We learn that Mr. W. J. Moore (formerly with Messrs. Henry Greene and Sons) has been appointed sole representative for Great Britain and the Colonies of Herr W. Breymann, the manufacturer of the "Meteor" gas-lamp, and has taken offices and a show-room at No. 83, Upper Thames Street, E.C.

Cromer Water Supply.—The Cromer Water Company, in view of the growing popularity of the town, have been engaged during the past two years in sinking a second well, capable of giving a supply considerably in excess of that hitherto available. The wells are situated more than half a mile outside the town. Owing to the sandy character of the upper strata, great difficulty was experienced in sinking the new well, which varies from 8 feet to 5 feet in diameter, and has been carried to a depth of 183 feet from the surface. The chalk was reached at a depth of 138 feet; and with the object of ensuring the purity of the supply by excluding all percolations from the strata above, the well has been lined to a depth of 151 feet with brickwork and iron cylinders. The new bore-hole, which is 20 inches in diameter, extends from the bottom of the well for a further depth of 40 feet. Two headings, each 6 feet by 4 feet, have been driven for a distance of 100 feet; one serving as a connecting link between the new well and the old bore-hole, by means of which the town has hitherto been supplied. The permanent water-level in the new well and old bore-hole is 110 feet from the surface; and, as already stated, all the water flows direct from the chalk. The well, with the headings, possesses a storeage capacity of about 25,000 gallons; and the total yield when the works are in full operation, will be at least 200,000 gallons per day—a supply that will suffice for the requirements of the town for many years to come, even at the present rate of progress. A new set of pumps and engine have been erected, designed to lift 12,000 gallons of water per hour; and the entire system is now in duplicate The water has recently been examined by Professor Frankland, who reported, on samples taken from each well, that the water was of excellent quality for dietetic purposes, absolutely free from all evidence of previous sewage or animal contamination, and, for chalk water, of very moderate hardness. He added that Cromer might be congratulated on being supplied with one of the best waters in Great Britain. The works have been carried out under the direction of Mr. J. C. Melliss, M.Inst.C.E.

Serious Damage to a Retort-House at the Bristol Gas-Works.—During a heavy thunderstorm with which Bristol was visited last Saturday night, considerable damage occurred to a retort-house at the Avon Street station of the Bristol Gas Company. The older buildings on the east side of the street comprise the coal-store and a retort-house extending round three sides outside the central building. The outer building contains about 254 retorts. The retort-house had an iron roof covered with tiles and slates; and although it was 60 or 70 years old, it was well constructed, and believed to be in good condition. Of the 254 retorts, 40 on the Marsh side were in action during Saturday night, and nine men were attending them. About one o'clock on Sunday morning, one of the men heard a great noise on the city side of the building, and gave warning to his companions, who ran out of the retort-house towards the river just in time to escape being crushed by the falling roof. Mr. Townsend, who resides on the premises, and the Chairman of the Company (Mr. J. W. S. Dix) were communicated with; and the latter directed that Mr. Fiddes and Mr. Phillips, the Engineer and the Secretary, should be called. These gentlemen were at Weston-super-Mare; and, as they could not be reached by telegraph or train at that hour, a messenger was despatched in a vehicle. At eleven o'clock they reached the works, where they met Mr. Dix, inspected the damage, and gave necessary instructions. The premises presented a most extraordinary appearance. It is believed that lightning struck the city end of the retort-house, displaced part of the roof there, and the collapse of the roof the whole length of the structure followed. Not a vestige of it was left upon the walls, which were uninjured. Strange to say, none of the ascension-pipes of the retorts were injured, so far as could be ascertained; neither was any part of the adjacent sheds damaged. Some 40 or 50 hands were called in; and in about 12 hours the *débris* was cleared from the retorts in use, and they were brought into action again; but, to prevent probable accident by heavy rain falling upon the hot retorts unprotected by a roof, other retorts in the newer premises on the other side of the street were lighted up, and when ready those in the roofless building were let down. The damage is roughly estimated at about £1000. Fortunately the disaster did not seriously interfere with the work of gas making.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The whole of the arrangements have now been made for the Stirling meeting of the North British Association of Gas Managers. The meeting is to be held in the Albert (Lesser) Hall, which is the same building, if not the same apartment, as the Association met in in 1887. Mr. Adam MacPherson, of Kirkcaldy, the President, will take the chair at half-past ten in the forenoon, and after the ordinary business will deliver his Inaugural Address. The technical business consists of four items, which will not crowd the day with too much. The first is the discussion on the paper on "Regenerative Gas-Lamps, with Special Reference to the Lighting of Large Interiors," which Mr. D. Macfie, of London, read at last year's meeting in Edinburgh, and which there was not time for the members to express their opinions upon. Provided that Mr. Macfie is allowed to open the discussion by stating any advances which may have been made in regenerative lighting during the year, this should be a valuable discussion. Mr. John M'Crae, of Dundee, will contribute a paper on "Coal Analysis." Mr. M'Crae has probably the most unique experience in Scotland in connection with the analysis of coal, and his remarks should be full of interest. Mr. John Mackay, of Peterhead, will amplify the remarks he made at the Informal Meeting in Glasgow last April, in a paper on "Enriching Coal Gas by Paraffin Oil or Liquid Hydrocarbons," giving his experience down to date. This will probably prove the most important paper before the meeting. The last item on the programme is of a more popular nature, and consists of a paper by Mr. George Keillor, of Nairn, on "How to Keep Down Complaints and Grumbling amongst Gas Consumers," an admirable subject to wind up with, after the members have been engaged in the more severe studies of the two previous papers. Mr. Carlow, the Secretary, is to be congratulated in securing contributions upon two such important subjects as the analysis of coal and the enrichment of gas, which are the leading problems before gas managers at present. If the members support the Committee by freely stating their experiences and opinions, the meeting should be one of great value.

The second day of the meeting will, as usual, be chiefly devoted to pleasure; but before starting on the customary excursion, the important ceremony of unveiling the bust of Murdoch in the Wallace Monument is to be performed. The Committee have been fortunate in securing the services of Lord Kelvin for the unveiling, which should lead to an interesting speech by the foremost scientist of the day in Scotland. Thereupon the party will return to Stirling to lunch; and afterwards will drive to Doune, going through the grounds surrounding Keir House, and returning by Bridge of Allan, reaching Stirling about eight o'clock at night.

I wish to be allowed to state, regarding Mr. MacPherson's remarks in this week's JOURNAL, that what I wrote a fortnight ago about the meeting place of the North British Association of Gas Managers was founded upon information by a member of the Association, though not of the Committee. I am heartily glad to learn that I was mistaken regarding Mr. M'Crae's attitude; because his support of the Stirling meeting will lead to a harmonious gathering. On the other matter alluded to, I hope it will be sufficient to point out that I did not deprecate the presence of the Dundee Corporation at the unveiling of the bust of Murdoch, but gave it as my opinion that their presence in an official capacity would have led to difficulties about precedence—a very important subject, and one which frequently gives rise to much heartburning—all which would be avoided by having only one corporate body present officially.

Sheriff Berry has affirmed the judgment of Sheriff-Substitute Erskine Murray in the action in which a printer claimed £7 12s. 8d. from the Glasgow Corporation as damages in respect that his works were stopped on Nov. 27, 1890, by a sudden failure in the supply of gas. The Corporation stated that the failure of the supply was owing to a sudden heavy fog. The decision of the Sheriff is that the pursuer has no relevant case. It is a valuable contribution to the law of gas supply; and it is of double importance in that, if not disturbed in a Superior Court, it affirms that a gas supplying body is not liable for any consequences arising out of the unforeseen contingency of a fog.

The accounts of the Dumfries Gas Commission were submitted on Monday. They showed an output of gas of 59,151,300 cubic feet—an increase of about 2,000,000 cubic feet on the preceding year. The yield of gas per ton of coal had also increased from 8530 to 9744 cubic feet. Gas sold amounted to 51,780,900 cubic feet; the unaccounted-for gas being at the rate of 12·46 per cent. The revenue from gas was £8950; and from residual products, £1744. The cost of coal was £5316. There was a profit on the year's working of £2215, out of which the customary charges for payment of interest and contributions to the sinking and reserve funds were made; and a sum of £735 was carried forward. Provost Scott, in moving the adoption of the accounts, said they proposed to use coal this year which would cost, on an average, 17s. 3d. per ton—3d. per ton less than last year—and they intended to supply gas of 25¼-candle power, or a half candle less than last year. By this means, they would be able to retain the price of gas at 3s. 6d. per 1000 cubic feet. They were paying off their debt at the rate of £1000 a year; and they now owed only £22,000 odd, whereas their assets were not less than £45,000.

The Lockerbie Gas Commission have finished the first full year of their existence. They have not yet, apparently, got altogether into harness. Their income was £735; and their expenditure, £832. This left a deficit of £97, which, however, has been reduced to £48 by a contribution from the contingent gas-rate.

The flourishing little Gas Commission at Alloa has concluded another very satisfactory year. While retaining, last year, the price at the rate of 5s. 4d. per 1000 cubic feet, their revenue from gas has risen from £5842 to £6418 and meter-rents, from £206 to £215, which shows an increase, both in the number of consumers and in the quantity of gas consumed. The total revenue was £7568; and the balance of profit on the year was £653.

The Elgin Gas Commissioners last year advanced the price of gas from 5s. to 5s. 5d. per 1000 cubic feet, which does not seem to have had much effect upon the consumption—the revenue from gas being £3863,

as compared with £3343 in the preceding year. There was a net profit on the year's working of £303. It was resolved, when the accounts were adopted on Monday, to continue the price of gas at 5s. 5d. per 1000 cubic feet.

The Dunbar Gas Commissioners are finding out what anybody with a knowledge of the business could have told them, that with a new Manager whom they expect to do better than his predecessor, they must be prepared to enter upon considerable expenditure. At this week's meeting of the Commission, what is described as "a formidable list of necessaries and alterations" was submitted by the Manager. These are to cost not under £300. Some of them were allowed, and the others were sent to the Committee for consideration. Might it not now occur to them that they probably dealt rather hardly with their former Manager, in requiring him to work with defective plant? That was his allegation all along; and they did not believe him.

The Burntisland Gas Commission have fixed the price of gas for the current year at 5s. 5d. per 1000 cubic feet, the same as last year. Over 11,000,000 cubic feet of gas were sold during the year; but, owing to the high price paid for coal, and losses in connection with the tar contract, there was a debit balance of £112. The sinking fund account shows £2596 at the credit of the Commission.

The Portobello Gas Company, under the management of Mr. D. Vass, is strengthening its position by the adoption of improvements in the works, which, the report of the Directors says, though they will cost £1000, will lower the cost of production so much that they expect to be able to reduce the price of gas. The cost of the alterations they propose to defray out of the reserve fund, which at present amounts to £888. During the past year their revenue was £7719, and their expenditure, £5358; which left a balance of £2360. A dividend at the rate of 8 per cent. was declared.

The output of gas at Broughty Ferry during the past year was 28,128,759 cubic feet; and the revenue from gas and residuals was £6384. There was a balance of profit of £283, which was carried to the contingent fund. The price of gas was reduced from 4s. 7d. to 4s. 2d. per 1000 cubic feet. The quality of the gas has been very much improved of late—being 26·35 candles, as compared with 21·61 candles some time ago.

The Gas Commissioners of the Aberdeen Town Council have purchased the Bon-Accord Mill, beside the gas-works. It is the intention of the Commissioners to utilize the building as a generating station, should the electric lighting scheme go on. The mill is very close to the gas-works; and about 18 months ago, on the occasion of a serious fire in it, there was a good deal of apprehension as to the safety of the works. Therefore, should the building not be required for electric lighting purposes, its purchase and the consequent removal of a source of danger from the proximity of the gas-works is a precautionary step which it was advisable to take.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 16.

Sulphate of Ammonia.—The market remains steady. But the tone on the whole is not quite as strong as it has been; and this is due to the action of some of the speculators, who have been taking orders at unnecessarily low prices. It is difficult to understand this movement, as the actual sales this week do not indicate a lowering tendency; and, unless appearances deceive, full prices will yet have to be paid by those who still require prompt parcels this month. Quotations remain at £9 18s. 9d. to £10, f.o.b. Hull and Liverpool, and £9 17s. 6d. f.o.b. Leith. Nitrate is still dull, but values unchanged.

LONDON, *July* 16.

Tar Products.—Pitch is the best article for tar distillers, although buyers will not pay within 3s. of to-day's price for next season's delivery. Benzol is flat; and the most buyers will pay is a shade under the prices quoted below. There is an increased demand for carbolic acid and cresol; and these products are sure to see better prices. The firmness which anthracene attained to a week or two ago has now disappeared; and this article is in very poor request, and the price continues to fall. Creosote and common oils are easier to sell; but prices are still miserably low. Business done during the week shows the following values: Tar, 8s. to 10s. 6d. Pitch, 27s. Benzols, 90's, 1s. 8d.; 50's, 1s. 3½d. Toluol, 1s. 2d. Solvent naphtha, 1s. 2d. Crude benzol naphtha, 30 per cent., 7d. Creosote, 1d. Naphthalene, 25s.; pressed, 45s. Carbolic acid, crude 60's, 1s. 3d.; 70's, 1s. 6d.; crystals, 6d. Creosol, 1s. Anthracene, 30 per cent., "A" quality, 9d.; "B" quality, 6½d.

Sulphate of Ammonia.—Very few transactions have been done during the week. Makers are firm in their ideas of value; and the stocks are low, and the make is at its lowest. It is not unlikely sulphate will improve in price. The shipments are much more diversified than they were a few years ago, notwithstanding the large increase in the production from coke-ovens, blast-furnaces, and other sources, during the past five years. It is all well taken up; and if it were not for the baneful influences of bear operators, the value of sulphate would be at least £2 per ton more than it is. Sales during the week have realized £9 16s. 3d. to £10, less 3½ per cent. discount. Gas liquor (10-oz.) is quoted at 5s. 6d. to 6s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—All descriptions of round coal continue in but slow request; and supplies are in excess of the demand, notwithstanding a very general restriction of the output. At the pit's mouth, quotations for best Wigan Arley remain at 12s. to 12s. 6d. per ton; for Pemberton four-feet and second qualities of Arley, 10s. to 10s. 6d. per ton; and for common house-fire coals, 8s. 6d. to 9s. per ton. In the lower qualities of round coal there is no improvement whatever in the demand, which continues very indifferent, owing to the slackness in most of the manufacturing industries. For inland sales, quoted prices for steam and forge coals remain at about 7s. 6d. to 8s. per ton, at the pit's mouth; but special transactions are frequently put through at less than these figures. The chief pressure, however, is in effecting business for shipment, where large quantities can be moved away promptly. With regard to gas coals, the position remains very much the same as reported of late. As anticipated, the competition from other districts, especially Yorkshire, is necessarily tending to weaken prices in Lancashire; and for contracts that have yet to be settled, some concession upon last year's rates is necessary. Users of gas coal during the latter part of the season have very generally followed out the policy of withholding their decision upon tenders until they have been able to secure some concession; and although Lancashire colliery owners have not been forced down in their price to any very material extent, a giving way of about 3d. per ton has recently been almost the rule—slightly more favourable terms than this being obtained in exceptional cases from representatives of collieries. Generally, prices for Lancashire gas coal may be said to be 3d. to 6d. per ton easier, as compared with the average ruling last year; and for the best qualities of screened gas coal, at the pit's mouth, the average rates can scarcely be quoted at more than 9s. 9d. to 10s. per ton, while in some cases, unscreened has been offered at very low figures. With regard to engine classes of fuel, the market maintains a very strong tone; the limited quantity of round coal now being screened causing rather a scarcity in the supplies of some descriptions of slack. At the pit's mouth, good ordinary descriptions of burgy are fetching 6s. 3d. to 6s. 9d. per ton; the best qualities of slack, 5s. to 5s. 6d. per ton; and medium sorts, 4s. 3d. to 4s. 9d. per ton. Common descriptions of slack, however, might still be bought at about 3s. 3d. to 3s. 6d. per ton.

Northern Coal Trade.—A very full demand has continued for coal; and the settlement of some important contracts has given firmness to the gas coal branch of the trade especially. Best Northumbrian steam coal varies in price from day to day; but the general quotation is 10s. per ton, free on board. Second-class qualities are 9d. to 1s. per ton less; and small steam coal is very plentiful at about 4s. 3d. per ton. In gas coals, the current quotation for best Durham is now 8s. 6d. per ton, free on board, though one or two collieries ask rather higher prices. Contracts for the great gas companies in the South are now under negotiation. Some have already been allotted, at about 7s. 10d. to 8s. per ton, free on board—a price which shows a reduction on the rates of a year ago. Other contracts will not be decided upon for three weeks; but the general idea seems to be that they will be on about the lines of those that have been decided in the last few days. Bunker coals are a little more in demand, but the price is weak; 8s. to 8s. 6d. being taken, though for the best qualities 9s. is asked. For best Durham screened bunker coals, 11s., less discount, is named. In coke there is a fuller production, and the price is slowly settling down to the rates that prevailed before the long strike. For export, best coke is quoted at 16s. per ton, free on board; but for local use, a rather lower figure is named. Gas coke is unaltered.

Scotch Coal Trade.—There has been a very great slackening in the coal trade in Scotland during the past few days; the miners having gone on their annual holidays. When these are over, the outlook, from the coalmasters' point of view, will not be very promising, as orders have, for the past week or two, come in slowly. Stock-bings, too, are very small; and should the demand improve, coalmasters will be at the mercy of the miners if they ask an increase of wages. On the other hand, they have little coal mined at the reduced rate with which to recompense themselves in the event of it being found impossible to raise the market rate. There is thus an air of doubt hanging over the market, which has a paralyzing effect upon forward orders. What trade has been effected has been at late rates, with the exception of main, which is a little easier. The quotations are: Main, 7s. 6d. to 7s. 9d.; ell, 8s. 6d.; splint, 8s. 3d. to 8s. 6d.; and steam, 10s. to 10s. 3d. per ton. The shipments for the past week were 159,794 tons, which was 16,766 tons in excess of those of the previous week, and 15,508 tons more than in the corresponding week of last year. For the year to date, the exports now amount to 3,801,967 tons—an increase of 572,167 tons over the same period of last year.

Gas, Water, and General Investment Trust Limited.—The Directors of this Trust have declared interim dividends, for the half year ending July 28, at the rate of 4½ per cent. per annum upon the preferred, and 5 per cent. per annum upon the deferred stock.

Sale of Stock.—At a sale by auction at Sheffield last Tuesday, £70 of consolidated "B" stock in the *Sheffield Gas Company* sold at £214 per cent.; £130 of "C" stock realized £212 per cent.; and £42 10s. of similar stock produced £212 per cent. A *Sheffield Corporation Water* annuity of £5, and one of £5 8s., sold for £142 10s. and £153 18s. respectively. A similar annuity of £2, increasing by 5s. every two years from 1888 until 1904, fetched £108.

Pollution of a Bolton Reservoir by Sewage.—For some time there has been a dispute between the Bolton Corporation and the Bolton Rural Sanitary Authority as to the alleged pollution of an extensive reservoir at Heaton belonging to the Corporation; and last Tuesday Colonel Hasted, R.E., held an inquiry on the subject. Great interest was taken in the matter, as a large population is affected by the outcome of the investigation. The Town Clerk (Mr. R. G. Hinnell) said the Heaton Water-Works cost £68,000; and a large sum had been expended in improvements to get a better and purer supply. The reservoir was situated in the Rural Sanitary Authority's district; and, owing to the locality not being sufficiently sewered, decayed vegetable matter and sewage from cottages and farms got into the reservoir, and made the water unfit for use. In consequence of the water being declared bad by the Borough Medical Officer, 69 million gallons had been run to waste at one time. Outside districts supplied by the Corporation complained of the quality of the water, and refused to pay their accounts. This was a very serious matter. Mr. Cooper, Clerk to the Rural Sanitary Authority, said they had a prescriptive right to turn the sewage on to the land; and it was also used for irrigation purposes by the farmers. It was not for the Authority to lay the sewers as requested; but they relied on the visit of the inspector to the place to settle the matter. A number of witnesses were called by both sides; and the inquiry was an exhaustive one. The inspector subsequently visited the district concerned.

Exhibition of Gas Appliances.—During the past week, an exhibition of Messrs. J. Wright and Co.'s "Eureka" cooking-stoves and other gas appliances was held at the Bedminster Town Hall. Cookery demonstrations were given twice daily by Mrs. J. Thwaites.

Additional Water-Works for Budleigh Salterton.—Mr. Arnold Taylor, one of the Inspectors of the Local Government Board, held an inquiry last Tuesday at Budleigh Salterton, into an application by the Local Board for sanction to borrow £2500 for constructing additional water-works. The source of the proposed supply is at Kersbrook, where there is a spring which yields 40 gallons of water per minute.

Gas Enterprise in the Colonies.—A copy of the *Australian Star* lately to hand contains an account of the opening of the gas-works at Yass, a town about 200 miles from Sydney; the ceremony being performed by his Excellency the Governor of New South Wales (the Earl of Jersey, G.C.M.G.). The Mayor of Yass (Mr. M. Coen) said the works just completed for the Municipality at a cost of £7000 were equal to a supply of 22,000 cubic feet of gas per day; and the Council estimated that, by charging 12s. 6d. per 1000 feet, they would have a revenue of £700 per annum. There were 7½ miles of mains. He complimented the Engineer (Mr. J. C. Alexander) and the Contractors (Messrs. M. Gill and Sons) on their successful work. The gas was turned on by the Mayoress in the presence of a numerous assemblage of townspeople.

Gas Explosion at Coventry.—A gas explosion, attended with serious consequences, occurred last Tuesday at Coventry. Early in the morning a milkman named Aston, on calling at a house in Easton Road, was informed by a servant that there was an escape of gas in the breakfast room; and he offered to find the whereabouts of the leakage. He entered the room with two servants, and foolishly struck a light. The next moment there was an explosion; and Aston and the girls were thrown violently to the floor. All three were severely burnt about the limbs, face, and head; and it was found necessary to convey Aston and one of the servants to the hospital, where it was thought they were likely to remain several days. The explosion shattered the contents of the room, demolishing the windows, and completely ruining some valuable pictures. The damage is reported to be considerable.

Extensions at the Cromer Gas-Works.—The Cromer Gas Company some time since called upon their Consulting Engineer (Mr. Jabez Church, M.Inst.C.E.) to examine their works and report upon the state of the plant. This he did; and, upon his advice, the Company have decided to undertake at once the erection of a gasholder for 22,000 cubic feet, and the provision of a new scrubber and a new purifier. The contract for the building work, including the gasholder-tank, has been let to Mr. J. K. Baker, of Fakenham, Norfolk; and that for the ironwork, to Messrs. W. C. Holmes and Co., of Huddersfield. The holder will eventually be a double-lift one; but only one lift will be put in at present, and provision made for adding the second at some future time. It is an indication of the rapid development of this popular seaside resort that in the two years 1889-91 the consumption of gas increased 36 per cent.

The Bradford Corporation Water Supply and Lead-Poisoning.—At an inquest held at Low Moor last Thursday on the body of Joseph Dalby, a forgeman, a verdict was returned to the effect that deceased had died from lead-poisoning, epilepsy, and exhaustion; and that the lead-poisoning arose from drinking water supplied to the inhabitants by the North Bierley Local Board, and purchased by them from the Bradford Corporation—such water having a solvent action upon lead. A rider was also added asking the Local Board to compel the Bradford Corporation to adopt measures for hardening the water at the source of supply, and thus destroy the solvent action. It is reported that this is the third death by lead-poisoning that has occurred in the district within the last few weeks. It was stated that the Board had communicated with the Local Government Board, the West Riding County Council, and the Bradford Corporation on the subject.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 108.)

Issue.	Share	When ex-Dividend.	Dividend on Last Issue.	NAME	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apr.	10½	Alliance & Dublin 10 p. c.	10	16½—17⅓	..	6 0 0
100,000	10	„	7⅓	Do. 7 p. c	10	11—12	..	6 5 0
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	103—103	..	4 15 3
100,000	20	27 May	8	Bahia, Limited	20	10—12	..	13 6 8
200,000	5	12 May	7½	Bombay, Limited	5	6—6½	..	5 15 9
40,000	5	„	7⅓	Do. New	4	4¼—4⅝	−⅛	6 6 4
380,000	Stck.	26 Feb.	12⅓	Brentford Consolidated	100	212—217	..	3 12 11
150,000	„	„	9⅓	Do. New	100	165—170	..	5 8 9
220,000	20	11 Mar.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	11 Mar.	5	Bristol	100	95—100	..	5 0 0
320,000	20	13 Apr.	11½	British	20	41—43	..	5 4 8
50,000	10	26 Feb.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	„	8½	Do. 7 p. c.	10	15—16	..	5 6 3
328,750	10	—	—	Buenos Ayres (New) Limited	10	6½—7½	..	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	92—95	..	6 6 4
150,000	20	26 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	13 Apr.	13	Commercial, Old Stock	100	231—236	+2	5 10 2
165,000	„	„	10	Do. New do.	100	180—185	..	5 8 1
130,000	„	15 June	4½	Do. 4½ p. c. Deb. do.	100	119—122	..	3 13 9
800,000	Stck.	15 June	13	Continental Union, Limited	100	218—223	..	5 16 7
200,000	„	„	10	Do. 7 p. c. Pref	100	185—195	..	5 2 7
75,000	Stck.	30 Mar.	10	Crystal Palace District	100	185—190	..	5 5 3
486,090	10	29 Jan.	10	European, Limited	10	19—20	..	5 0 0
354,060	10	„	10	Do. Partly paid	7½	14—15	..	5 0 0
5,470,820	Stck.	12 Feb.	12	Gaslight & Coke, A, Ordinary	100	210—215	..	5 11 8
100,000	„	„	4	Do. B, 4 p. c. max.	100	94—98	..	4 1 7
665,000	„	„	10	Do. C, D, & E, 10 p.c. Pf.	100	250—255	..	3 18 5
30,000	„	„	5	Do. F, 5 p. c. Prf.	100	118—123	..	4 1 3
60,000	„	„	7½	Do. G, 7½ p. c. do.	100	169—174	..	4 6 2
1,300,000	„	„	7	Do. H, 7 p. c. max	100	157—162	+3⅓	4 6 5
463,000	„	„	10	Do. J, 10 p. c. Prf.	100	250—255	..	3 18 5
476,000	„	„	—	Do. K, 6 p. c. Prf.	100	148—153	..	3 18 5
1,061,150	„	15 June	4	Do. 4 p. c. Deb. Stk.	100	114—116	..	3 9 0
294,850	„	„	4½	Do. 4½ p. c. do.	100	119—123	..	3 13 2
908,000	„	„	6	Do. 6 p. c. do	100	163—166	..	3 12 3
3,800,000	Stck.	12 May	12	Imperial Continental	100	215—219	..	5 9 7
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	4—4¼	..	6 13 4
560,000	100	1 Apr.	5	Met. of Melbourne, 5p. c. Deb.	100	108—110	..	4 10 11
541,920	20	15 June	5	Monte Video, Limited	20	14—15	..	6 13 4
150,000	5	27 May	10	Oriental, Limited	5	7⅞—8⅛	..	6 1 2
60,000	5	30 Mar.	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	26 Feb.	2	Pará Limited	10	2—3	..	—
420,000	100	3 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	106—110	..	5 9 1
500,000	100	1 June	6	2nd Do.	100	100-103	..	5 16 7
150,000	10	15 Oct.	10	San Paulo, Limited	10	8—9	..	—
500,000	Stck.	26 Feb.	15½	South Metropolitan, A Stock	100	267—272	..	5 14 0
1,350,000	„	„	12	Do. B do.	100	220—225	+2	5 6 8
200,000	„	„	13	Do. C do.	100	230—240	..	5 8 4
725,000	„	14 July	5	Do. 5 p. c. Deb. Stk.	100	140-144*	+½	3 9 6
60,000	Stck.	11 Mar.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
743,952	Stck.	1 July	10	Chelsea, Ordinary	100	248—253	..	3 19 1
1,720,252	Stck.	13 Apr.	8	East London, Ordinary	100	195—200	..	4 0 0
544,440	„	1 July	4½	Do. 4½ p. c. Deb. Stk.	100	137—140	..	3 4 3
700,000	50	1 July	8½	Grand Junction	50	100—104	+1	4 1 9
708,000	Stck.	12 Feb.	10½	Kent	100	260—265	..	3 19 3
1,043,800	100	1 July	9½	Lambeth, 10 p. c. max.	100	222—227	..	4 3 8
406,200	100	„	7½	Do. 7½ p. c. max.	100	191—196	..	3 16 7
279,700	Stck.	30 Mar.	4	Do. 4 p. c. Deb. Stk.	100	122—125	..	3 4 0
500,000	100	12 Feb.	12½	New River, New Shares	100	325—335	..	3 22 4
1,000,000	Stck.	29 Jan.	4	Do. 4 p. c. Deb. Stk	100	127—130	..	3 1 6
902,300	Stck.	15 June	6½	S'thwk & V'xhall, 10 p. c. max.	100	148—153	..	4 4 11
126,500	100	„	6½	Do. D 7½ p. c. do.	100	134—138	..	4 14 5
1,155,066	Stck.	15 June	10	West Middlesex	100	237—242	..	4 2 8

*Ex div.

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Telegrams: "GWYNNEGRAM LONDON." **GWYNNE & CO.,** TELEPHONE No. 2698.

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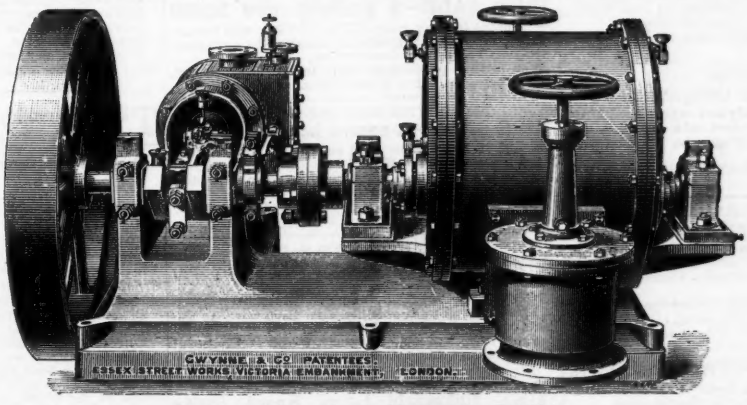
Thirty-three Medals at all the Great International Exhibitions have been awarded to GWYNNE & Co., for Gas Exhausters, &c.

They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality.

The result is that in every instance their work is giving the fullest satisfaction.

They have completed Exhausters to the extent of 30,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work, and can be referred to.



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GWYNNE & Co.'s Exhausters are constructed of large size to pass the required quantity of Gas at very slow speeds; the wear and tear being reduced to a Minimum.

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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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WASHERS, from 500,000 to 250,000 feet per diem.
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EXHAUSTERS, from 120,000 to 5000 feet per hour.
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Applications, in own handwriting, with three recent testimonials of character and ability, and stating age, where now employed, when at liberty, and salary expected, to be addressed to the Chairman, Gas Office, Newcastle-on-Tyne, not later than the 1st day of August.
W. HARDIE, Secretary.
June 27, 1892.

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Apply to R. VENNER, Secretary, Royal Agricultural Hall Company, Limited, ISLINGTON.

TENDERS FOR TAR.

THE Dukinfield Local Board invite TENDERS for the TAR produced at the Gas-Works during the ensuing Twelve months and amounting to about 650 tons.
Tenders to be sent in by Noon on Monday, the 25th of July, at Local Board, King Street.
HARRISON VEEVERS, Engineer.
Dukinfield, July 9, 1892.

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THE Hinckley Local Board invite TENDERS for a MECHANICAL SCRUBBER-WASHER, to pass 200,000 cubic feet per 24 hours.
For further particulars apply to the undersigned.
E. H. MILLARD, Engineer and Manager.

CITY OF BELFAST.

THE Gas Committee of the Belfast Cor- poration invite TENDERS for the supply and erection of IRON and STEEL WORK in connection with new Stage Floor Retort-House and Benches.
Drawings and Specification may be inspected at the Engineer's Office, Gas-Works, Belfast.
Copy of Specification, with Form of Tender attached, can be had on payment of One Guinea, to be returned on receipt of a *bond fide* tender.
For the convenience of parties unable to inspect Plans at the Works, it has been arranged to supply a complete set of Drawings and Specification on payment of Three Guineas (not returnable).
Tenders, endorsed "Tender for Iron and Steel Work, Retort-House," must be lodged in the Town Clerk's Office, Town Hall, Belfast, not later than Wednesday, the 10th of August, 1892.
The Committee do not bind themselves to accept the lowest or any offer.
JAMES STELFOX, Engineer.

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

ASHFORD, KENT.

TENDERS FOR COAL.

THE Directors of the Ashford Gas and Coke Company, Limited, are prepared to receive TENDERS for the supply of 3000 tons of GAS COAL, to be delivered, at their Works at Ashford (Kent), in equal monthly quantities from the 1st of August next to the 31st of March, 1893.

Tenders, specifying the description of Coals, the Pits at which they are raised, and terms for net monthly payments, to be sent to me on or before Saturday, July 23, endorsed "Tender for Coals."

F. HUGHES HALLETT,
Secretary.

Ashford, July 13, 1892.

ALDERSHOT GAS AND WATER COMPANY.

COAL CONTRACT.

ABOUT 6000 tons of Coal are wanted by the Aldershot Gas and Water Company, either first-class Durham, Yorkshire, Bath, or West Country Coal. The Durham Coal to be delivered at the Nine Elms Wharf of the L. & S. W. R. Company; and the Yorkshire or West Country Coal at either the Aldershot or Tongham Stations, L. & S. W. R.

Tenders are invited not later than the 29th inst., addressed to the Offices of the Company.

103, Victoria Road, Aldershot,
July 13, 1892.

TENDERS FOR COAL.

THE Broadstairs Gas Company invite TENDERS for the supply of 2500 tons of the best NEWCASTLE GAS COAL, to be delivered in good condition into Carts provided by the Company in Broadstairs Harbour, or f.o.b. Vessels in the Tyne, from August, 1892, to July, 1893.

The Directors do not bind themselves to accept the lowest or any tender.

Sealed tenders, endorsed "Tender for Coal and Freight," or for "Coal," to be sent in on or before Tuesday, Aug. 2, 1892, addressed to the Chairman of the Company.

Further particulars can be obtained of the undersigned.

W. J. LATCHFORD,
Secretary and Manager.

Gas Offices, Broadstairs,
July 9, 1892.

TENDERS FOR FREIGHT.

THE Broadstairs Gas Company invite TENDERS for the FREIGHT of 2500 tons of COAL from the Tyne to Broadstairs Harbour, delivered into Carts provided by the Company, from August, 1892, to July, 1893.

The Directors do not bind themselves to accept the lowest or any tender.

Sealed tenders, endorsed "Tender for Freight," to be sent in on or before Tuesday, Aug. 2, 1892, addressed to the Chairman of the Company.

Further particulars can be obtained of the undersigned.

W. J. LATCHFORD,
Secretary and Manager.

Gas Offices, Broadstairs,
July 9, 1892.

TO COAL OWNERS.

THE Directors of The Gaslight and Coke Company are prepared to receive TENDERS for the supply of 1,500,000 tons, more or less, of COAL, for a period of Ten months from the 1st day of September next, in accordance with the terms of their Specifications.

Deliveries can be made either by Ship in the Thames or by the principal Lines of Railway, which are in connection with the several Works of the Company.

Copies of the Specifications and Forms of Tender can be obtained upon application at this Office; and all tenders must be sent in before Noon on Wednesday, the 3rd of August, addressed to me, and endorsed "Coal Tender."

By order,
JOHN ORWELL PHILLIPS,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., July 13, 1892.

CORPORATION OF BEVERLEY.
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee are desirous to receive OFFERS for supplies of COALS for a period of one year.

The Coals are to be delivered as from time to time directed by and at the expense of the Contractors f.o.b. at Keadby.

The Coals are to be the best of their kind, well screened (description, sizes, and inclination of Screen to be specified), to be as free as possible from Sulphur, Bats, Bind, Refuse, and Dirt, and shall be weighed (20 cwt. to the ton) upon the Corporation machine.

Payments will be made monthly if and so long as the contract shall be duly fulfilled.

The Corporation do not bind themselves to accept the lowest or any tender.

Further Information and Forms on which the tenders must be made may be obtained on application to me, or to Mr. Bryan, at the Gas-Works, Beverley; and the tenders (sealed) specifying the description of Coals, the Seam and the Pits at which they are to be raised, and stating the prices for delivery at Keadby, and in manner and subject to the conditions aforesaid, must be delivered to me on or before the 27th day of July, 1892.

By order,
JAMES MILLS,
Town Clerk.

Guildhall, Beverley,
July 13, 1892.

HEALTH EXHIBITION, New Drill Hall, Portsmouth, including Sanitary Apparatus and Appliances, Arrangements for Water Supply, Heating and Cooking Apparatus, Electric Lighting, Smoke-Preventing Appliances, Articles relating to Personal Hygiene, Domestic Economy, Foods, Clothing, Life and Labour Saving Appliances, &c., to be held from Sept. 12 to Oct. 8, 1892, in connection with the Autumn Congress of the Sanitary Institute.

Prize Medals and Certificates of Merit will be awarded for approved exhibits.

Forms of Application for Space and all Particulars can be obtained from the CURATOR, Mr. W. H. Knight, 74a, Margaret Street, LONDON, W.

BRISTOL GAS COMPANY.

TENDERS FOR GAS COAL AND CANNEL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of their requirements (say, 130,000 tons) of GAS COALS during the period commencing the 1st of October next, and ending the 30th of June, 1893.

Particulars and Forms of Tender may be obtained on application to the undersigned, to whom also tenders, sealed and endorsed "Tender for Coal," must be delivered not later than Ten a.m., on Monday, the 8th day of August next.

JOHN PHILLIPS,
Secretary.

Chief Offices: Canon's Marsh,
Bristol, July 13, 1892.

BOROUGH OF ROCHDALE.

TO CHEMICAL MANUFACTURERS.

THE Gas Committee of the Corporation invite TENDERS for the supply of such quantities of BROWN OIL OF VITRIOL as they may require during the ensuing Twelve months.

The Acid to be made from Pyrites or recovered Sulphur, and to be delivered at the Rochdale Railway Station.

Further information can be obtained from Mr. T. B. Ball, Manager, Gas-Works, Rochdale.

Tenders, endorsed "Vitriol," must be sent to me not later than Noon of Wednesday, the 27th inst.

By order,
ZACH. MELLOR,
Town Clerk.

Town Hall, Rochdale,
July 16, 1892.

TENDERS FOR GAS COAL.

THE Directors of the Exmouth Gas Company invite TENDERS for the supply of about 2000 tons of clean, dry, unscreened, fresh wrought GAS COAL.

Tenders to be for price f.o.b.; also price delivered free at Exmouth Docks, between the 1st of August next and the 30th of June, 1893, accompanied by working analysis.

Sealed tenders, addressed to the Chairman, and endorsed "Tender for Coal," to be delivered to the Company's Office not later than Saturday, July 30, 1892.

No tender necessarily accepted.

By order,
JAMES T. FOSTER,
Secretary.

Gas-Works, Exmouth,
July 5, 1892.

MILLOM LOCAL BOARD.

TENDERS are invited for the supply of 1500 tons of GAS COAL, at such times and in such quantities as the Board require during Twelve months from the 1st of September next.

The Coal must be of the best quality, and as free as possible from Bats, Pyrites, and Dross.

Full particulars of the Coal and Colliery, and an epitome of the working analysis to be given.

The price per ton, delivered free at Millom Station, and (where applicable) at the nearest and most available Port to the Colliery or Depôt, to be stated.

Sealed tenders (on forms which can be had on application to the undersigned), endorsed "Tender for Coal," to be sent in to me not later than the 8th of August next.

The Board will not be bound to accept the lowest or any tender.

W. T. LAWRENCE,
Clerk to the Board.

Local Board Offices, Millom,
July 16, 1892.

SPALDING GAS-WORKS.

THE Spalding Improvement Commis- sioners invite TENDERS for the supply of 500 tons (or any larger quantity that may be required) of best GAS NUTS, to be delivered in such quantities as shall be from time to time required and ordered by them, or by their direction, up to the 30th day of June, 1893.

Sealed tenders to be endorsed "Tender for Coals," stating the price per ton (of 21 cwt.), delivered into the Stores at the Gas-Works in Spalding, and to be sent to the undersigned at the Office of the Commissioners, 8, Double Street, Spalding, on or before the 23rd day of July inst.

The Commissioners will also receive TENDERS at the same time for the supply of 20 tons, or any greater or less quantity that may be required, of LIME, suitable for Gas Purification, to be from time to time delivered on the same terms and in the same manner as above mentioned.

The Commissioners do not bind themselves to accept the lowest or any other tender.

H. H. HARVEY,
Clerk to the Commissioners.

Spalding, July 1, 1892.

GREAT WIGSTON GAS COMPANY.

TENDERS FOR COAL.

THE Directors invite Tenders for 1900 to 2100 tons of best screened GAS COAL (21 cwt. to the ton), delivered at the Railway Station, Wigston, for Twelve months, commencing July 1, 1892, in such quantities as the Manager shall order from time to time.

Tenders to be addressed to the Chairman not later than the 25th of July inst.

The Directors do not bind themselves to accept the lowest or any tender.

JOHN A. HARRIS,
Manager.

July 8, 1892.

TO CONTRACTORS.

THE Market Harborough Gas Company invite TENDERS for
2000 Tons of screened GAS COAL.
100 Tons of LIME.
26 Tons of SULPHURIC ACID.

The Coal must be sent in monthly, and as directed by the Manager, Mr. Armitage, of whom any further information may be obtained.

Tenders, giving price per ton at Market Harborough Station, to be sent to Wm. Gilbert, Esq., Northampton Road, Market Harborough, by the 1st of August next.

The lowest or any tender not necessarily accepted.

CHAS. BURGOINE,
Clerk.

July 9, 1892.

LINCOLN CORPORATION.
(GAS DEPARTMENT).

TENDERS FOR COAL.

THE Gas Committee of the Lincoln Cor- poration invite TENDERS for the supply of 19,000 tons of screened GAS COAL, COBBLES, and NUTS, to be delivered during a period commencing the 1st of August, 1892, and terminating the 30th of June 1893.

Further particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 23rd inst.

The Committee do not bind themselves to accept the lowest or any tender.

JNO. CARTER, Manager.

Gas Offices, Lincoln,
July 4, 1892.

LINCOLN CORPORATION.
(GAS DEPARTMENT.)

TENDERS FOR TAR & AMMONIACAL LIQUOR.

THE Gas Committee of the Corporation of Lincoln are prepared to receive TENDERS for the purchase of the surplus TAR, and of the whole of the AMMONIACAL LIQUOR produced at their Works during the period of One year, commencing on the 1st of July, 1892.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Residuals," must be delivered at the Gas Offices, Newland, on or before the 23rd inst.

The Committee do not bind themselves to accept the highest or any tender.

Information as to quantities and other particulars may be obtained of the undersigned.

JNO. CARTER, Manager.

Gas-Works, Lincoln,
July 4, 1892.

TENDERS FOR GAS COAL.

THE Directors of the Clayton, Allerton, and Thornton Gas Company invite TENDERS for the supply of 5000 tons of GAS COAL and 500 tons of CANNEL COAL. The Coal to be Screened, free from Scale, Sulphurous Pyrites, or other objectionable matter, and to be delivered at the Gas-Works, Low Lane, Clayton, or at the Great Northern Railway Station, Clayton, in such quantities weekly as may be ordered by the Company's Manager, during the next Twelve months. The said tenders to state the Seam and the Pit from which the Coal is intended to be sent.

Sealed tenders, endorsed "Tender for Gas Coal," addressed to the Chairman, at the Gas-Works, to be delivered at or before Noon on Monday, the 25th day of July, 1892.

The Directors do not pledge themselves to accept the lowest or any tender, reserving to themselves the right to divide the contracts as they may think proper.

By order,
JOHN NIVEN,
Secretary and Manager.

Gas Offices, Clayton,
Near Bradford, July 8, 1892.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS and WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS and WATER SHARES, at the Auction Mart, Tokenhouse Yard, E.C.

The next Sale will take place at the Mart on Monday, July 25, at Two o'clock precisely, and will consist of Shares in the following Companies:—

Romford Gas and Coke Company. (Sale of 400 Shares by order of the Directors.)
Brighton and Hove Gas Company.
Enfield Gas Company.
West Ham Gas Company.
Harwich Gas Company.
West Kent Gas Company.
Sunbury Gas Consumers' Company.
The London and General Bank, Limited.

Terms for including Shares in these Sales, and all particulars relating thereto, may be had of Mr. ALFRED RICHARDS.

Offices: 18, FINSBURY CIRCUS, E.C.

Price 2s. per dozen, or 10s 6d. per 100, post free.

CONSPIRACY and Protection of Property Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

*** *The Act extends to Scotland and Ireland.*

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, NEAR DEWSBURY.

COKE BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT.)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

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Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.

Is cheap and easily fixed to any form of main,

Will be found the most efficient appliance of the kind yet introduced.

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ALFRETON IRON-WORKS, DERBYSHIRE,

AND

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CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

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SILICA BLOCKS,

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OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY

Strongly recommended where EXCESSIVE HEATS have to be maintained.

For FIRE-BRICKS, the most durable for GAS-FURNACES,

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Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.

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TELEGRAMS: "PIPES GLASGOW."

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OF EXTRA QUALITY FOR MAKING

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TAR, LIQUOR, AND SPENT OXIDE Purchased for Cash against Delivery.

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HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production nearly 3000 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16½ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves 69 per cent. of excellent Coke. During the year 1890, the London Gas Companies carbonized about 400,000 tons of HOLMSIDE COALS. They are used by The Gaslight and Coke Company, the South Metropolitan Gas Company, the Commercial Gas Company, the Woolwich (Government) Gas-Works, the Newcastle and Gateshead Gas Company, the European Gas Company, the Ipswich Gas Company, and by many other Gas Companies both at Home and Abroad.

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HOLMSIDE AND SOUTH MOOR OFFICES,
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Cannel and Gas Coal Merchants,
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CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL
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SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

ROSEWELL BOGHEAD.
Yield of Gas per ton . . . 13,215 Cub. Ft.
Illuminating Power . . . 37·56 Candles.

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Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
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TYNE BOGHEAD CANNEL.
Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.,
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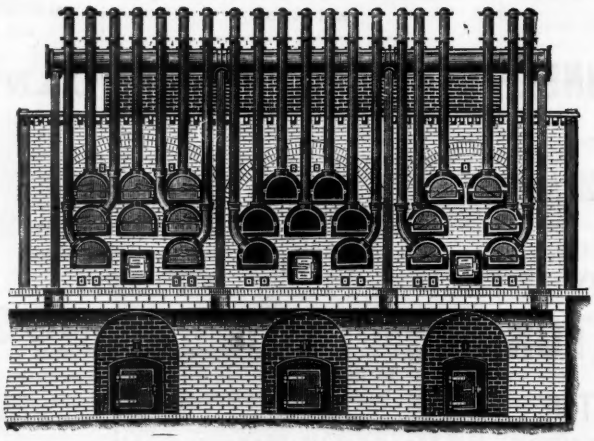

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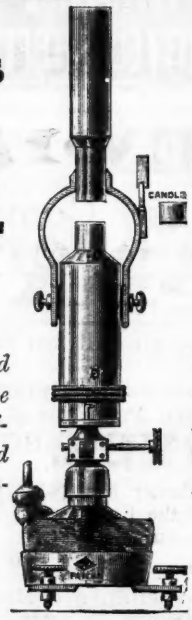

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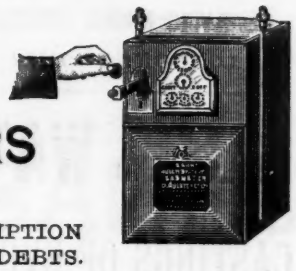

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SPECIALLY ADAPTED FOR INCREASING CONSUMPTION AMONG SMALL CONSUMERS. NO RISK OF BAD DEBTS.

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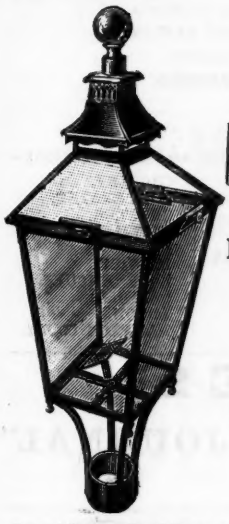

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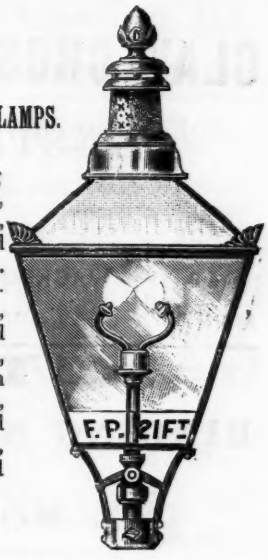
SPECIAL HIGH-POWER LAMPS.

For Lighting Streets, Refuges, Promenades, &c., where a good light is required. Fitted with Porcelain cone, Copper top and perforation, Wrought-Iron Spray, Lever Tap, Burner, and Patent Governor, glazed with Opal top.



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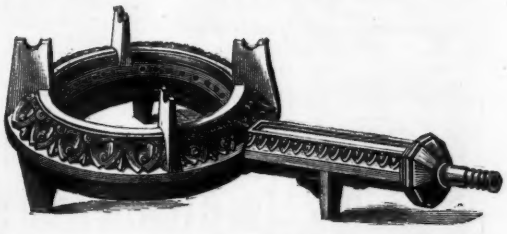

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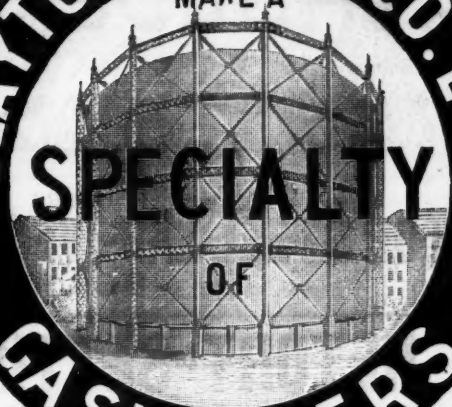

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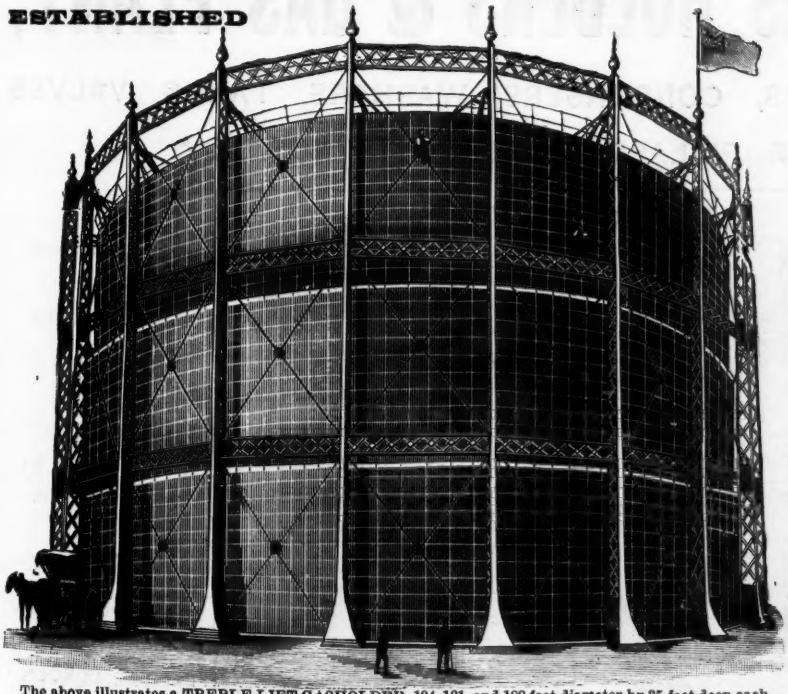

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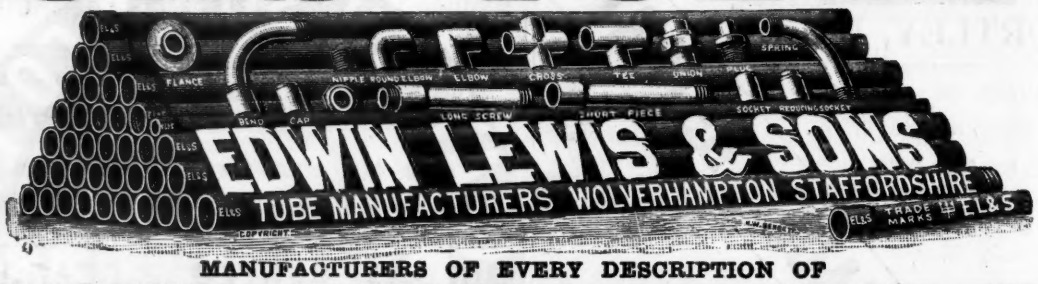

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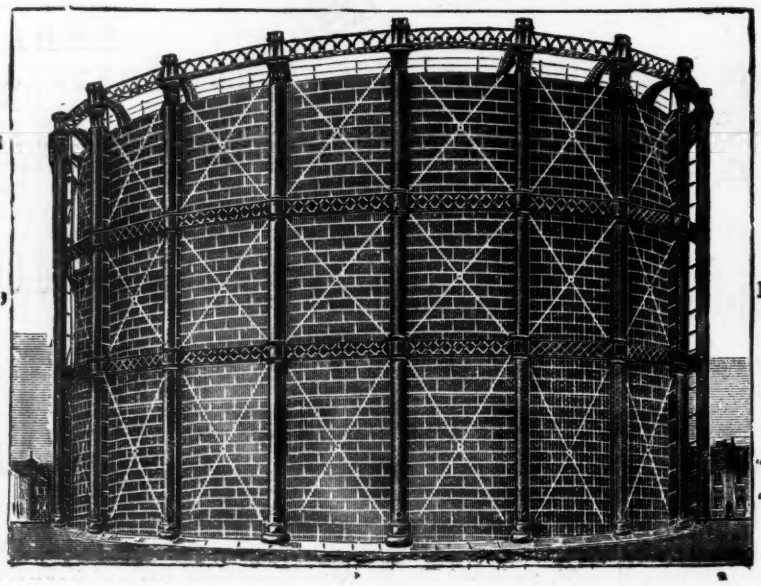

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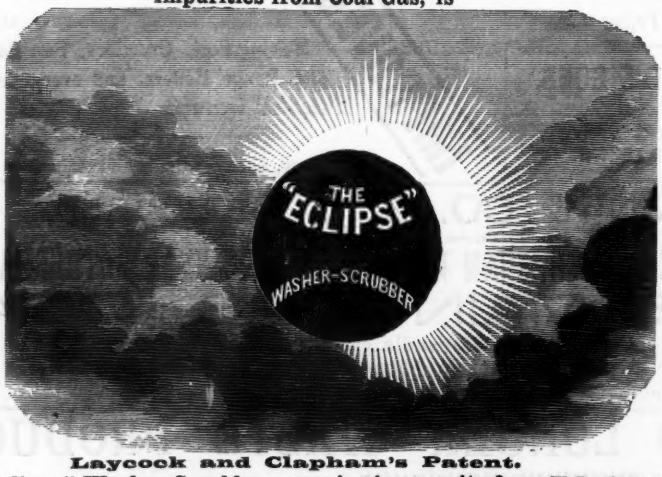

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